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AMERICAN JOURNAL OF OPHTHALMOLOGY

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DIRECT UTILIZATION OF THE EYE AS A CAMERA*

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It is generally recognized that Christopher Scheiner, the Jesuit philosopher, was the first to demonstrate the actual formation of an inverted image upon the retina by making a window at the posterior pole of the eye. Although the date of this experiment is generally given as 1619,[1] (the date of publication of his "Oculus hoc est," according to Von Rohr, who has translated Scheiner's works from Latin into German) Scheiner did not report this actual demonstration upon the eyes of animals until publication of his "Rosa Ursina" in 1925.[2,3] Scheiner's original monographs were unobtainable by the essayist for verification.

The camera obscura had been invented long before Scheiner's investigations and has been credited to Giambattista della Porta (1545-1615), although Leonardo da Vinci and Don Pronrince[4] may have antedated Porta, and Polyak finds evidence that its principle was known to the ancient Greeks.[5] In spite of the obvious comparison of the eye to the camera obscura there was considerable reluctance, both before and after Scheiner's momentous contribution, to accept as a fact the inversion of the retinal image, a premise which had first been evolved upon theoretical grounds by Kepler in 1611.[6]

Prior to Joannes Kepler's monumental contributions as a pioneer in physiologic optics there had been no clear idea of the mechanism of the formation of the retinal image, and, in fact, little advance from the early Galenic hypothesis of the lens as the receptor of visual impulses. Following the publication of Scheiner's classic experiment numerous investigators corroborated his findings, which have become, especially when performed with an albinotic eye, a standard laboratory demonstration in physiologic optics. In 1638 Rene Descartes removed the posterior wall of the eye and replaced the retina with the flat surface of another object, upon which the image was observed.[5]

Finally in 1877, Kühne,[7] in carrying out extensive studies on visual purple, produced his famous "optograms," which led to the popular fallacy (still persisting) of the face of the murderer being observed on the retina of the victim. What Kühne did accomplish was to produce an image on the retina by prolonged exposure, light causing a change in the rhodopsin which could be observed grossly for a short time. Using albinotic rabbits, eyes of birds, or, in some cases, eyes with a thin sclera and only moderate choroidal pigmentation, he brought the

*From the Department of Ophthalmology of Northwestern University Medical School. Candidate's thesis for membership in the American Ophthalmological Society, June, 1944.

image (usually a flame, but in some cases a large photographic negative held against the sky) to a focus on the retina as exactly as possible by observation of the sclera (as a ground glass) at the posterior pole of the eye. The animal had first been dark-adapted for 15 minutes, decapitated, and the eye enucleated under a sodium light. After exposure, the duration of which he varied but which usually was for several hours, the eyes were placed in 4 percent aluminum potassium-sulfate solution for 24 hours in the dark. The purpose of the alum solution was to make the subsequent removal and inversion of the retina more readily accomplished and *did not serve to fix the image,* as had been widely misquoted but emphatically denied by the author himself. He was not successful in "fixing" the image chemically in a photographic sense, but after the retina was inverted by punching out the optic nerve and removing the retina under water, he could observe the optogram in the floated retina for as long as 30 minutes and if the retina were then dried in a desiccator the image persisted for a much longer period. The image of the flame was well reproduced, but more complicated subjects, such as the photograph of a man, did not show details well.

In 1926 Hidano[8] photographed for the first time the image formed by the eye. He constructed an apparatus consisting primarily of a metal tube 35 mm. in diameter with a circular opening in the base 12 mm. in diameter. Into this the freshly enucleated eye of a dog was placed with the cornea protruding through the opening. Plaster of Paris was placed around the eye to hold it in position and a large window was made at the posterior pole of the eye, by removing the sclera, choroid, and retina. Behind the eye was a closed chamber with a piece of glass at the back and an ingenious device connected with a mercury manometer by which the intraocular pressure could be controlled through use of Ringer's solution in the chamber. The cornea was also protected by a chamber containing Ringer's solution. He found that if the tension were not controlled the globe would collapse and if the cornea were not protected it would become clouded. By using a mirror at a 45-degree angle behind the apparatus and a photographic camera in the proper position, the image formed by the eye was reflected by the mirror into the camera, and it was possible to obtain quite clear photographs with a resulting magnification of about three times. These photographs gave no information as to the refraction of the eye, as a clear picture could be obtained whether the image was formed in the vitreous, the normal position of the retina, or even behind the globe. In a subsequent experiment[9] he inserted a screen in the normal position of the retina, photographing the image on the screen with various lenses placed in front of the eye. A thin layer of paraffin was placed between two cover glasses to form this screen, which was arranged so that it could be moved forward or backward by means of a screw. This screen meant that, departing from the method of his first experiments, he was now photographing the image approximately as it would be formed *on the retina.*

Lashley[10] in 1932, photographed the image in albino rats' eyes, the sclera of the undissected eye being used as a screen upon which the image was formed. The eyes were kept in a moist chamber throughout the experiment, and it was found that good transparency could be maintained for as long as 30 minutes.

Since the invention and development of the modern camera, with its almost universal use throughout the civilized world and the wide understanding of its general principles, the comparison between

the photographic camera and the eye has naturally and repeatedly been made, especially when attempting to describe the function of the eye to the general public.[11] Verbitzky[4] has even calibrated the relative apertures of the schematic eye in terms of photographic lenses as f/6, f/4, and f/12 for pupils of 4 mm., 6 mm., and 2 mm., respectively.

In spite of this frequent comparison of the eye to a modern photographic camera and the retina to the sensitized emulsion on the photographic plate or film, a thorough study of the literature does not reveal any evidence that any investigator has ever attempted to *substitute* such film for the retina and thus actually utilize the eye as a camera. While Hidano, Lashley, and possibly others have photographed the retinal image as previously described, they made use of a camera for that purpose and in no case registered the image on sensitized photographic emulsion placed within the eye itself.

In contemplating the possibilities of direct utilization of the eye as a camera certain difficulties are at once suggested. It is self-evident that all media must remain as transparent as possible. Post-mortem changes are especially apt to cause corneal clouding, particularly if the epithelium becomes dry for too long a period of time. Reduction of intraocular pressure incidental to opening the globe may further contribute to loss of transparency. These factors Hidano felt it necessary to overcome to maintain ocular transparency, and to that end he constructed the somewhat complicated apparatus already described. Eyes should be used as soon after enucleation as possible, and if any appreciable time interval elapses it would seem desirable that precautions be used to keep the tissues as well preserved as possible to avoid more than minimal post-mortem changes. Since the globe must be opened posteriorly to admit the photographic film (which because of its pliability would seem more suitable than a plate) every effort must be made to prevent vitreous loss, and some method would have to be employed to assure that the film was placed in the proper position, comparable to that normally occupied by the retina. Since the image will be small (not enlarged by the process of photography as in Hidano's experiments) it is desirable to utilize a very fine-grain photographic emulsion. Mees[12] has emphasized the fact that since the photographic image consists of grains, no matter how sharp the edge of the theoretical image which produced it may be, it will appear more or less ragged under high magnification. The resolving power of an emulsion is the product of three factors—graininess, turbidity, and contrast—giving a very complex reaction. Therefore, no matter how fine-grained an emulsion is used, it is not to be expected that it will be possible to obtain too clear a positive print if one attempts to enlarge a negative with an image in any way approaching the small size of the macular image. It is consequently to be expected that an area much larger than the macula must be utilized.

With these difficulties anticipated, an attempt was made to substitute photographic film for the retina in the eyes of various animals, and to obtain on that film photographic images by utilizing the eye as a camera. In the series of experiments conducted, the eyes of pigs, sheep, beeves, cats, and rabbits were employed. The first three were obtained fresh from the Chicago stockyards, the latter two were from laboratory animals, the eyes being enucleated just prior to the experimental procedures. It was found that sheep's eyes were the most satisfactory for this work; they approximate the human eye anatomically (although they are larger in all dimensions, averaging 28 mm. in length),

the media remain clear, and the vitreous is not so fluid as that of rabbits or cats. Beef eyes were too large for satisfactory comparison to the human eye, and pigs' corneas tend to become clouded, for the animals are sprayed with an antiseptic solution before being slaughtered, in accordance with U. S. Government regulations. All eyes from the stockyards were used as soon as possible, but there was of necessity an interval of several hours between the time of their removal and their use in the laboratory. Immediately upon receipt from the slaughterhouse they were placed, wrapped as delivered, in a refrigerator with the temperature set at 5°C. With these precautions the media remained grossly quite clear and a very clear view of the fundus could be obtained with the ophthalmoscope.

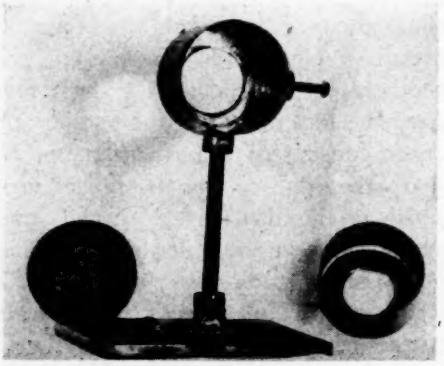


Fig. 1 (Mann). Apparatus for holding eye. Shows outer tube mounted in stand (center); inner cup for eye with optical glass in back (lower right); and metal cap (lower left).

The first attempts to obtain a photographic image were made by simply placing a strip of unexposed film in front of the retina. Two parallel incisions, about 4 mm. long and about 3 mm. on either side of the estimated position of the macula, were made through the sclera, choroid, and retina. Working in the dark with only a photographic safety lamp, the writer placed a strip of film 4 mm. wide through one incision, across in front of the retina, and out the other incision. The film was then pressed forward slightly on the lateral side of each incision to make it fit snugly against the retina and conform to its curvature. This was accomplished without appreciable loss of vitreous. The whole posterior segment of the eye was then covered with a dark cloth to eliminate extraneous light and an attempt was made to photograph a visual-acuity chart about 17 feet away, using a flashlight bulb. A very fast film, Super XX, was employed. In spite of repeated attempts along this line and the use of various exposure times, no image was obtained on the film. Only a black spot was recorded, showing that the portion of the film within the eye had been exposed to light.

It was realized that in this crude original effort no attempt had been made to get the image into focus and that if the eye were other than perfectly emmetropic with relaxed accommodation in this post-mortem state one could not hope for a clear retinal (or photographic) image, without the use of a ground glass for focusing.

With the assistance of Mr. Hunter of the Belgard-Spero Optical Company, a metal container was constructed to hold the eye (fig. 1). This consisted of a piece of brass tubing 26 mm. long and 46 mm. in diameter, the front end open and the back end containing an opening in the brass 23 mm. in diameter, into which was cemented a piece of very thin optical glass, curved as nearly as possible to the posterior conformity of the globe. This inner cup for holding the eye was fitted snugly into a slightly larger piece of brass tubing with an open front and a circular opening in the back 28 mm. in diameter, and mounted on a standard to insure

steadiness and ease of handling. A metal cap was made to fit over the back of the outer brass cylinder into which could be placed a metal ring with a central opening, in case it was desired to place the film in position and protect it before being exposed. In practice, however. this cap and ring were not used, as no time was lost between getting the image into focus and then photographing it. Over the front of the outer cylinder could be placed a camera shutter to assist in regulating the time of exposure and if desired, narrowing the size of the effective pupil, which in these animals was usually quite dilated. Such a shutter was used in a number of the experiments performed but, in general, proved to be of no great advantage, all exposures being instantaneous. For other types of objects photographed it might, however, offer an advantage.

Fig. 2 (Mann). Sheep's eye mounted and held by plaster in inner cup, which has been assembled into outer tube. Note set screw at side for keeping position of inner cup firm. Eye ready for use as a camera.

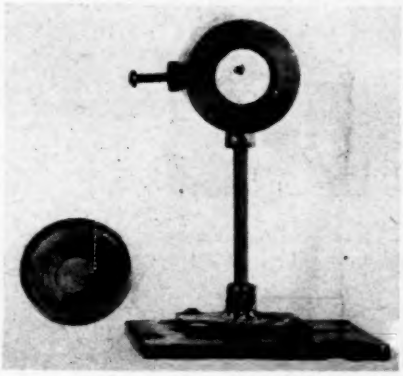


Fig. 3 (Mann). View from rear of holder containing sheep's eye, showing window in coats of eye at posterior pole. Sclera fits firmly against optical glass.

In preparing the eye for photography, it was first necessary to dissect from the sclera all adherent fat and connective tissue, then a small square window, approximately 4 mm. in size, was cut at the posterior pole of the eye in the estimated position of the macula, by the use of a cataract knife and sharp scissors to remove the window of sclera, choroid, and retina. It was found possible to do this without appreciable loss of vitreous or noticeable collapse of the globe. Holding the eye with the window up, the inner brass tubing was placed over it, so that the window was snugly against the optical glass at the back. The eye was held in this position while the whole was inverted. In order to hold the eye in the proper position with the window against the optical glass and not permit any loss of vitreous, a quick-setting plaster (Kerr's Snow White Impression Plaster No. 2) was poured around the eye from in front. This held it securely, and it was not found that the plaster reached the posterior part in any way to interfere with visualization through the glass and window. Dental cement (S. S. White) was also tried for this purpose; it held the globe securely but became so hard it was difficult to remove, hence its use is not recommended. The inner tube was then mounted in the outer holder, being pushed completely to the

back of it, so that the center of the optical glass protruded slightly through the opening in the outer cylinder (figs. 2 and 3). During this process of preparation the media usually remained quite clear, and with an ophthalmoscope one could read newspaper print placed against the optical glass. In some cases the cornea was irrigated with normal saline solution at short intervals.

A part of a visual acuity chart had been photographed on a negative which was

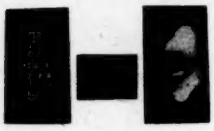


Fig. 4 (Mann). Instantaneous exposure of visual-acuity-chart negative with transmitted light.

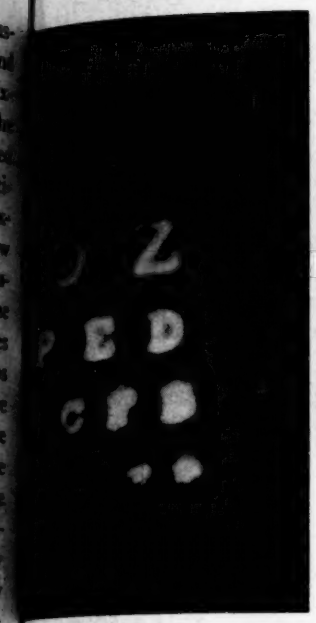
Fig. 5 (Mann). Newspaper headline with daydaylight and 1/50 second exposure.

Fig. 6 (Mann). Human eye, 60-watt bulb, and 1/10 second exposure.

placed on the front of an ordinary viewing box, giving a constant illumination from behind, with the letters appearing white against a black background. When the eye in its holding apparatus was directed toward this object the letters from this chart were seen sharply and distinctly as inverted letters in the window at the back of the eye. It was noted, however, that this was true for any and all distances at which the eye might be placed from the chart. This was due to the fact that the image was clearly seen by the observer's eye whether it was formed in the vitreous, in the retina, or in the air behind the window. This was demonstrated by placing a small piece of ground glass against the optical glass. When this was done the letters were visualized on the ground glass *only* when very exact focusing was done by varying the distance of the eye from the object, a very slight increase or decrease of this proper distance for focusing then causing the image to blur and disappear entirely. Many films were exposed with negative results before the need of such precise focusing was realized in practice, although it had been anticipated on a theoretical basis. The extremely sharp image seen in the window had been deceptive; thereafter all focusing of the image was done with the ground glass. It was found in all cases that for a sharp focus on the ground glass the distance from the object to the eye must be rather close, as might in part be accounted for from the fact that these animal eyes often showed a slight degree of myopia when viewed with the ophthalmoscope, this being further increased by the fact that the film was of necessity placed slightly behind the normal position of the retina, with the thickness of the choroid, sclera, and optical glass lying in front of the film. Post-mortem changes together with lowered intraocular pressure might also be a factor in exaggerating the apparent myopia.

When this apparatus was used, as indicated above, with a small piece of film backed with black photographic paper held over the optical glass behind the window, satisfactory photographic images were obtained of the visual-acuity chart and several other objects as indicated in the illustrations (figs. 4 to 12). Exposure time could not be measured exactly except in a few cases in which the shutter was employed; in the majority the exposure was instantaneous, the light in the viewing box being snapped rapidly on and off. After the proper position of the eye had been determined by use of the ground glass the film was placed in position in the dark by the sense of touch and exposed and immediately developed.

Every effort was made to keep the cornea clear by keeping it moistened with



7 (Mann). This is figure 4
larged about seven times.

Fig. 8 (Mann). This is figure 5 enlarged about five times.

Fig. 9 (Mann). This is figure 6 enlarged about six times.

normal saline, and fresh eyes were used after every few exposures. However, in one case a satisfactory photograph was made after an eye had been kept overnight in an icebox. In some cases, when the eye appeared to be abnormally soft, normal salt solution was injected into the vitreous with a hypodermic syringe, to produce an approximately normal ocular tension. No other effort was made to maintain the intraocular pressure at a normal range, but especially when sheep's eyes were used the eyes did not appear to develop sufficient hypotension to produce effects deleterious to the object of the experiment.

While the practical importance of utilizing the eye for a camera and obtaining an image which approximately corresponds to the image cast on the retina of the eye in life may not be overwhelming, it does suggest possibilities in physiologic optics, at least in a demonstration of well-known hypotheses. For example, the size of the retinal image in relation to the object and the distance could be well demonstrated, especially with further improvements in technique. Our difficulty in this regard, in spite of repeated attempts, lies in the extremely small size of the retinal image when the object is at any distance, making photography of distant objects almost impossible. Accepting the hypothesis that the smallest resolvable retinal image must have a diameter just greater than a macular cone (about 0.002 mm. according to Schultze[13]) we must conclude that present photographic emulsions would not permit photographing an image approaching the minimum visual angle. For practical purposes this is considered to be about one minute, although on theoretical grounds it would be less. Adler[14] has called attention to some of the factors that may influence the visual acuity, such as errors of refraction, size of

the pupil, intensity of illumination, and use of monochromatic light (experimental). He has also called attention to other factors, such as the aligning power of the retina, which is much more sensitive than the resolving power and which, together with physiologic influences, may greatly increase the visual acuity. In determining standards of visual acuity, the minimal visual angle of 60 seconds has been generally accepted, however, as the normal. In photographing retinal images we can, of course, eliminate all physiologic factors, but we must substitute those of a physical or mechanical nature, especially as related to the nature of the photographic emulsion.

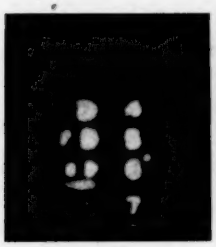


Fig. 10.

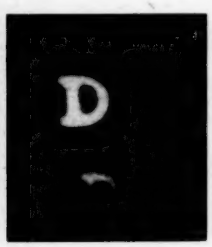


Fig. 11

Fig. 12.

Fig. 10 (Mann). This is a photograph obtained with a rabbit's eye, enlarged about four times.

Figs. 11 and 12 (Mann), These are higher magnifications of images obtained with sheep's eyes.

The size of the retinal image is dependent upon the visual angle formed by the object and not upon the distance of the object from the eye, so long as the distance is within the limits of accommodation, as emphasized by Southall.[15] Although there is a theoretical difference in the size of an image from an object subtending 1 degree at the anterior principal point of the eye from the state of full relaxation of accommodation to greatest accommodative effort, this shows a difference in size of the image between 0.293 mm. during relaxation and 0.286 mm. during accommodation, and may therefore be disregarded.

The simplest formula for determining the theoretical size of the retinal image is quoted by Duke-Elder[1] as follows, where AB is the object, ab the image, and N the nodal point of the eye:

$$ab : AB = bN : BN$$
$$ab = AB \times bN/BN$$
$$\text{Since} \quad bN = 17.054 \text{ mm.}$$
$$i = 17.05 \times O/D$$

where O is the size of the object and D its distance from the nodal point of the eye.

Since the length of the eye will not always conform to the measurements of the schematic eye the image will be slightly larger in an axially myopic eye and smaller in an axially hyperopic eye.

Attempts to prove these relative image sizes were not too successful with the sheep's eye and this photographic method. For example, in a sheep's eye—which required a —18.00D. lens in the ophthalmoscope to visualize clearly newspaper print held against the optical glass, with the eye placed as described in the holder, indicating an effective myopia of —18.00D.—it was found that the image was brought to a focus on the ground glass when the eye was placed 5.5 cm. from the object to be photographed. When a —13.00D. lens was placed 1 cm. in front of the cornea, the distance from the object to the cornea required to obtain a sharp focus was increased to 18.7 cm., findings quite consistent with the degree of myopia as estimated. Satisfactory exposures of the film were made at these distances. Measurement of the "O"

in the "TOZ" on the developed film at the 18.7-cm. distance from object to cornea showed it to measure 0.9398 mm. in its greatest horizontal meridian. Estimating the distance from the object to the nodal point of the eye as 198 mm., and measuring the actual horizontal diameter of the "O" in the object photographed to be 13.43 mm., should, according to the formula for estimating image size, give a resultant image of 1.1873 mm. (instead of the actual 0.9398 mm.). Several other estimations at other distances gave a similar discrepancy with about the same proportionately small size of the actual image that could be theoretically deduced.

As an explanation of this apparent error it should be emphasized that the formula used for computing the image size is based upon the findings for the *human* eye with a nodal point 17.05 mm. in front of the retina. The sheep's eye, being somewhat longer (average 28 mm.) and having a different corneal curvature, will naturally have a different nodal point, the distance of which in front of the retina has apparently never been calibrated. If one could assume the accuracy of the conditions under which the image was formed and photographed to be comparable to that existing in the living eye, it might be possible to deduce from the known formula for image size the position of the nodal point in the sheep's eye. In order that the image formed should measure 0.9398 mm. in the foregoing experiment, with the distance to the cornea 187 mm. (and therefore 215 mm. from the object to the retina or film) one would have to assume that the nodal point was approximately 14 mm. in front of the retina. This is proved by the formula:

$$i = N \times O/D$$
$$i = \frac{14 \times 13.46}{201} \text{ or } 0.9353$$

It does not seem reasonable to assume that the nodal point in any eye 28 mm. long lies as far back as 14 mm. in front of the retina and no such claim is made. It would seem probable that the technical difficulties involved together with post-mortem and ocular-tension changes and the myopia noted account for the apparent error.

Further discrepancies occurred when the eyes used for photography were placed at any great distances from the object which were incompatible with the degree of refractive error estimated. For example, in one eye with an estimated 18 diopters of myopia (to the film, not to the normal position of the retina) a focus was obtained when the cornea was 5.5 cm. from the object, as would be expected. With a −7.50D. sph. placed 2.5 cm. in front of the cornea the distance was 6.5 mm., and with a −13.00D. sph. the distance increased to only 11 cm.; with a −17.00D. sph. to 12.5 cm., and with a —20.00D. to only 20 cm. The image became so minute at this distance that it was impossible to carry the experiment further.

It is realized that the images in all these experiments are not macular images only, due to the very obvious impossibility of photographing such minute images by present methods. Further objections may be made to the fact that the position of the film was slightly behind the normal position of the retina, Since no claim is made that the images formed are any indication of the vision obtained by the animal in life (as no consideration is given to the function of the higher visual centers) the fact that much more than the fovea is involved in the formation of these images is not really a valid criticism. The main object has been to demonstrate that the eye can actually be used as a camera, a fact that is of interest chiefly because of the frequent comparison made

between the two. It is conceivable that with future developments in photography it may be possible to demonstrate mathematically the size of retinal images according to the accepted formulas, and perhaps to prove experimentally other theories in physiologic optics.

No human eyes were available for this study, but there is no reason to expect any important facts to be demonstrated by their use which cannot be brought out with these animal eyes, with the possible exception of more accurate determination of image size.

30 North Michigan Avenue.

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THE USE OF ARTIFICIAL-FEVER THERAPY IN OPHTHALMOLOGY

IVAN C. SMITH, MAJOR (MC), A.U.S., AND GILBERT C. STRUBLE, LT. COL. (MC), A.U.S.

While fever-producing agents are commonly and effectively used by ophthalmologists, the use of so-called artificial or mechanical methods of fever production have not been commonly employed in this field. The most frequently used agents have been triple typhoid vaccine, sterile-milk injections, and similar agents. It is our belief that artificial or mechanical fever has been neglected in many cases when its use might have been more effective than the agent employed.

Most objections which have been raised to the use of artificial fever we believe have been based on unsound grounds. Many of these accounts are based on reports of techniques which were in use before the artificial methods of production were developed to their present degree. Also some are based on the technique used in the treatment of sulfanomide-resistant gonorrhea, which requires prolonged sessions of high fever and is not comparable to the techniques usually employed in treating ocular diseases. Some of the objections frequently made to the use of mechanical methods will be mentioned and evaluated in an effort to correct the impressions which we believe to be in error.

1. It is thought by some that other methods possess a nonspecific action which operates even when no fever is produced. This theory has been advanced since the early days of malarial therapy, but no conclusive proof that it is true has ever been introduced. In most instances it is noted that therapeutic results obtained are usually in direct relation to the height of the febrile reaction.

2. Another objection frequently heard is that the mechanical treatment is too strenuous. Most of our treatments were not over two hours in length, given at a therapeutic elevation of not over 105°F. and frequently less. The total elevation time was not over 3½ to 4 hours. When it is remembered that with artificial-fever therapy there is no preliminary chill, with its attendant malaise and headaches, it is obvious that it is actually less strenuous than fever therapy induced by triple typhoid vaccine. Some patients (other than eye) who have received both triple typhoid vaccine and 8-hour sessions of fever above 106°F., have stated to us that they prefer the latter method, their chief objection to typhoid vaccine therapy being the chill.

3. Another contention is that artificial fever is more dangerous. There have been many more deaths and serious complications reported from the use of foreign protein and vaccines than from artificial means. While it is true that many more such treatments have been given, the incidence of serious complications in mechanical fever is probably not proportionate. Most serious accidents encountered in artificial therapy have been in the cases treated with long high fevers. Another safety factor is that the mechanical methods require expert care by trained technicians, and there is no danger that they will be carelessly given. The same facts may be used to answer another objection raised; namely, that more nursing care is needed when treatment with mechanical fever is employed. Certainly a patient with a temperature of 105°F. needs just as much care regardless of the cause of the fever. If a patient is to be given an injection of typhoid vaccine in the office and sent home, the nursing care is not given but the risk is increased. If it is given in the hospital the problem of nursing care is

just as great. It is probably much safer to give a short session of mechanical fever in the morning and to allow the patient to return to his home that evening.

4. The expense factor is frequently mentioned. While this will vary in different localities, it will be equalized in most cases if the patients are hospitalized for their vaccine therapy and treated on an ambulatory basis with mechanical means. This is practicable because the mechanical method is controllable and can be completed in a few hours, leaving the average patient in the same condition as before the treatments. In military practice, there is no difference, for the patients are hospitalized in both instances.

The unavailability of mechanical-fever therapy is the most justifiable objection. However, it has been neglected even where it is available in favor of other methods, probably because more practitioners are familiar with the other methods. If mechanical fever is popularized, there is no reason to believe it will not be made generally available.

Mechanical methods of producing fever do have certain disadvantages. Once a patient is started on malaria therapy or has received an injection of vaccine or foreign protein, he cannot decide to discontinue the treatment. There are several ways in which he can cause the mechanical treatment to be discontinued, as his coöperation is necessary to the successful administration of the treatment. He may not keep all his appointments for mechanical-fever sessions.

In our opinion, however, the advantages of mechanical-fever therapy far outweigh the disadvantages, one of the greatest advantages being that temperatures of any duration and height are easily obtained, and that if necessary they may be repeated on the following day.

Drug therapy need not be discontinued during fever. In the series of cases herein presented, it will be noted that in most instances mechanical fever has been employed with chemotherapy in the form of either sulfadiazine or penicillin.

The Eye Department at this general hospital finds that Army and Navy personnel react erratically to the intravenous injection of triple typhoid vaccine. It is believed that this is a result of their routine immunization to typhoid and paratyphoid organisms. In rare instances these patients appear to have developed a sensitization to the vaccine and will develop unduly high temperatures. One such patient developed a temperature elevation of 106°F. for four hours following the intravenous injection of 25 million killed organisms. In most cases, however, the febrile reaction leaves much to be desired. In our experience the temperature elevation rarely is greater than 100.6° and frequently not over 99.6°F., following the first injection (25 million killed organisms).

Another objection to the use of triple typhoid vaccine in some instances is the fact that it cannot safely be used on two successive days. This is due to the possible occurrence of a second reaction on the day following its injection.

This fact together with the uncertainty of the febrile reaction places the attending ophthalmologist at a serious disadvantage. Prompt, adequate, and repeated fever therapy is a sight-saving measure in many eye diseases. This is particularly true of the following conditions:

1. Beginning intraocular infection following penetrating injuries.

2. In acute optic neuritis or retrobulbar neuritis of inflammatory origin.

It is not unusual in such cases for vision to drop from normal to light perception in only a few hours' time. Recovery following adequate fever therapy is frequently just as spectacular.

3. In acute secondary glaucoma due to blockage of the iris angle with inflammatory debris. Particularly is this true of those cases in which repeated paracentesis and other means have been unsuccessful in controlling the tension.

4. In acute iridocyclitis.

5. In cases of severe corneal ulcer and corneal abscess. Space does not permit a résumé of all of the many types of ocular pathologic change which respond favorably to fever therapy. These have been well covered in many previous reports by competent observers. Cordes[1] has made a comprehensive report of this subject together with a very complete bibliography.

The following cases treated by artificial-fever therapy at Billings General Hospital are reported. This group does not constitute all the ophthalmologic cases treated by this method. A variety of different pathologic conditions is presented to show the possibilities of mechanical-fever therapy. It will be noted that a number of cases are included which had been treated previously with triple typhoid vaccine with unsatisfactory results. To date, no complications whatever have been encountered.

Case reports

Case 1. Disciform macular degeneration (Kuhnt Junius type). E. R. H., aged 35 years was admitted to the Eye Service, Billings General Hospital, on February 21, 1944, complaining of blurred vision in the right eye of three weeks' duration.

Vision on admission was: O.D. 20/20 −2, J1 blurred (uncorrectable), macropsia present, and O.S. 20/20.

The eye examination was negative except for the following fundus changes in the right eye: There was a slaty-gray oval elevated lesion one-half disc diameter in size at the temporal margin of the fovea. This was elevated one-half diopter. Hemorrhage in the deep layers of the retina was noted along the temporal margin of the lesion and there was some subretinal infiltration, with hemorrhage extending below and nasally to the fovea. A 4-degree absolute paracentral scotoma was present.

A diagnosis of Kuhnt Junius macular degeneration of the juvenile type, right eye, was made. The patient was thoroughly studied. The throat, sinuses, and prostate were negative. Dental consultation and full mouth X-ray studies revealed an advanced degree of peridontal infection, for which a complete extraction was ordered. Blood studies including the serologic tests for syphilis and agglutination tests for undulant fever were negative. The Frei test was negative. X-ray studies of the chest and medical consultation failed to demonstrate any evidence of pulmonary disease. Intradermal skin tests, using old tuberculin in the dilution 1 to 10 million, were strongly positive. Because of the nature of the pathologic change in this type of lesion (hemorrhage beneath Bruch's membrane)[2] it was felt some form of therapy should be used which might cause the absorption of this bleeding. In view of the patient's extreme sensitivity to tuberculin, the close proximity of the lesion to the fovea, and the fear of a focal reaction following tuberculin therapy, with the likelihood of permanent loss of central vision, it was decided to withhold tuberculin therapy until fever therapy could be given a trial.

The first fever treatment was given on

March 1st. Therapeutic time 2 hours; temperature elevation 105°F., total elevation time 4 hours, 15 minutes. Penicillin (100,000 units dissolved in normal saline) was administered intravenously during the therapy. Examination of the fundus oculi the following day showed no evidence of exacerbation of the lesion, and absorption of a large part of the deep retinal hemorrhage. Four more fever treatments were administered.

March 6th. Therapeutic time 4 hours; elevation time 5 hours, 35 minutes. Temperature elevation to 105°F., with simultaneous administration of 100,000 units of penicillin, by intravenous injection. *March 9th.* Therapeutic time 3 hours; elevation time 4 hours, 50 minutes. Temperature elevation to 105°F.; 100,000 units of penicillin were given by intravenous administration during the treatment. *March 13th.* Therapeutic time 3 hours; elevation time 5 hours, 10 minutes. Temperature elevation to 105°F.; penicillin, 100,000 units, administered by intravenous injection. *March 16th.* Therapeutic time 3 hours; elevation time 5 hours, 15 minutes. Temperature elevation to 105°F.; penicillin, 100,000 units, administered by intravenous administration.

During the period of treatment all evidence of active bleeding at the margins of the lesion had disappeared. The lesion itself had become flattened and much less conspicuous. After the first fever treatment on March 1st, removal of the diseased teeth was begun. Extractions were followed by ophthalmoscopic study to be on the alert for any evidence of focal eye reaction. No such reaction occurred and the elimination of all dental foci was accomplished without incident. Vision on March 24th was holding at 20/20−2, and the patient was discharged to duty after dental prostheses had been fitted. He has been followed at intervals in the Eye Out-Patient Department since. The vision remains 20/20−2 and there has been no evidence of reactivation of the macular disease.

We believe that fever therapy arrested the progress of the macular lesion in this case. It is of further interest that improvement in the fundus picture began after the first treatment and prior to the removal of the dental sepsis. The cleaning up of the dental infection following fever therapy may have played a role in maintaining arrest of the lesion.

CASE 2. CHRONIC RECURRENT SUPERFICIAL PUNCTATE KERATITIS WITH SECONDARY IRIDOCYCLITIS. E. H. L., a colored officer, aged 26 years, was admitted to the Eye Service, Billings General Hospital, on May 30, 1944, for treatment of a bilateral chronic recurrent keratitis and iridocyclitis of eight months' duration.

Vision on admission was: O.D. 20/200, J1, correctable to 20/20−2 with −3.00D. sph. O.S. 20/100, J1, correctable to 20/25−1 with −3.00D. sph.

Pertinent findings at this Hospital were those of a bilateral recurrent superficial punctate keratitis, with some associated photophobia and blepharospasm due to secondary iritis. The conjunctiva showed only a moderate hyperemia, and repeated smears and cultures of conjunctival scrapings were negative. Both eyes showed numerous 1-by-1-mm. round, healed, corneal opacities, most marked at the limbus, and a few scattered similar opacities in the center of the cornea of the left eye. This patient had been thoroughly studied during his eight months of continuous hospitalization prior to admission here.

Repeated serologic tests for syphilis were negative. One tooth, R-14, had been extracted because of a periapical abscess. Allergy study had shown nothing sig-

nificant except a strongly positive patch test to tuberculin. Desensitization to tuberculin had been carried out for the preceding 2½ months, the patient having received 40 injections up to the time of his transfer to Billings General Hospital. Penicillin therapy, 15,000 units each injection, had been given by intramuscular injection over a 5-week period at 3-hour intervals day and night with only questionable benefit.

Fever therapy using typhoid vaccine had been unsatisfactory. Seven treatments in all had been given, the fever response to the first injection was 101°F., to the second 100°F., and to the next five injections the temperature elevation had varied from 99 to 99.6°. Biopsy specimen from a cervical gland with guinea-pig injection had been negative in 1941. Local treatment had consisted of the administration of atropine and hot compresses locally, a high-caloric and high-vitamin diet, with addition of riboflavin.

Following the patient's admission here, he was again carefully surveyed. X-ray studies of the chest, sinuses, and teeth were negative. The prostate gland was normal. Local treatment was continued; namely, atropine and hot compresses. Various local antiseptics, zinc sulphate, and metaphen brought about no improvement. Penicillin as local eye drops made up in normal saline (1 c.c. per 1,000 units, 3 drops) was given every hour during the day and every 2 hours at night for 2 weeks without benefit. General measures consisted of a high-caloric, high-vitamin diet with riboflavin and fortified with 75,000 units of vitamin A daily. Tuberculin desensitization was continued.

In spite of this therapy, however, the multiple areas of superficial punctate keratitis continued to recur in crops of 5 to 7 at a time. These would take a stain with fluorescein for 4 to 5 days and then gradually heal, leaving no permanent opacity. On slitlamp study they appeared to involve only the outer half of the corneal epithelium. They were apparently less severe than the previous lesions, which had left permanent corneal opacities.

A prominent and consistent finding in this case had been an almost complete bilateral corneal anesthesia. Because of this fact, it was felt the disease might be largely on a neurotrophic basis. Because nothing else seemed to be offering this patient relief of his symptoms, it was decided to try fever therapy in the fever cabinet. The treatments were given as follows:

August 7th. Therapeutic time 2 hours, at 105°F.; elevation time 3 hours, 15 minutes. *August 10th.* Therapeutic time 2 hours, at 105.6°F.; elevation time 3 hours, 10 minutes.

A striking feature of the local ocular reaction to fever in this case was the prompt return of corneal sensitivity. This was noted the day following the first treatment and has been maintained. At the present writing, September 26th, both eyes have been free from the recurrent keratitis for over five weeks. Both eyes remain white and quiet and the patient has no symptoms referable to either eye.

CASE 3. GLAUCOMA, SECONDARY, CHRONIC. E. E. H., aged 37 years, was admitted to Billings General Hospital on January 28, 1944, complaining of intermittent pain over the left frontal and temporal regions, and blindness, pain, and redness of the left eye. The vision in the left eye had failed 12 years before. The right eye had no significant symptoms. The left eye showed an injected globe with a steamy cornea, a deep anterior chamber, seclusion and occlusion of the pupil, and an ocular tension of

60 mm. Hg (Schiøtz). The left eye was also divergent about 20 degrees. Slitlamp examination showed no evidence of active iridocyclitis. Enucleation of the blind painful eye was advised but was refused, and the patient expressed a desire that some other surgical procedure be tried first in an effort to save the globe. A cyclodiathermy operation was performed on February 4th, three rows of diathermy-needle punctures being made over an area of two thirds of the ciliary body. At the same time the divergent strabismus was corrected by a tenotomy of the externus and a resection and advancement of the internus.

The postoperative reaction subsided slowly; on February 12th the tension had dropped to 43 mm. Hg. Fever therapy was advised in an effort to speed recovery and was given as follows:

February 15th. Therapeutic time 2 hours, 1 minute, at 103.3°F.; elevation time 3 hours. *February 21st.* Therapeutic time 3 hours, 15 minutes, at 103.5°F.; elevation time 4 hours, 45 minutes. *February 23d.* Therapeutic time 2 hours, at 103.3°F.; elevation time 2 hours, 30 minutes. *February 28th.* Therapeutic time 2 hours, at 103.3°F.; elevation time 3 hours, 30 minutes. *March 4th.* Therapeutic time 3 hours, at 105.3°F.; elevation time 5 hours, 5 minutes. *March 8th.* Therapeutic time 3 hours, at 105°F.; elevation time 5 hours, 15 minutes. *March 13th.* Therapeutic time 3 hours, 10 minutes, at 105.4°F.; elevation time 4 hours, 40 minutes. *March 16th.* Therapeutic time 3 hours, 5 minutes, at 105°F.; elevation time 4 hours, 30 minutes.

During this course of fever therapy the tension of the eye had gradually dropped to normal [13 mm. Hg (Schiøtz) on March 17th] and the globe had become white. This patient noted so much relief of pain and congestion of the eye following the first fever therapy that he asked that the treatment be continued. He was discharged to duty with a cosmetically good, quiet eye, and complete relief of the headaches.

It is our belief that fever therapy in this case hastened absorption of the postoperative reaction in the globe, materially increasing the patient's comfort and speeding his convalescence.

CASE 4. IRIDOCYCLITIS BILATERAL WITH CENTRAL EXUDATIVE CHOROIDITIS. R. E. C. was admitted to Billings General Hospital on November 1, 1943, for treatment of a recurrent gonorrheal urethritis. He had had three courses of sulfathiazole at previous hospitals but no permanent cure of his urethritis had resulted. He was treated with penicillin, 50,000 units divided into five 10,000-unit doses and given at 3-hour intervals. Following this therapy, he developed a clinical cure and was discharged on November 16th, but the urethritis again recurred and the patient was again hospitalized on December 7th, at which time he was given 100,000 units of penicillin divided into 10 doses given at 3-hour intervals. This therapy effectively cured the urethritis and the patient was discharged on December 13, 1943. On December 30th, he was admitted to the Eye Service, Billings General Hospital, for treatment of an acute iridocyclitis of the left eye. Vision on admisson was O.D. and O.S. 20/20, vision in the left eye being a little blurred. All foci of infection were eliminated. Repeated examinations of the prostate were negative for evidence of recurrence of his gonorrhea. The tonsils were removed. A full-mouth X-ray study showed periapical abscess of L-7 and 8, and these teeth were extracted. The blood serology was negative. Local eye treatments consisted of the administration of atropine and hot compresses. Foreign-protein therapy was instituted, using triple

typhoid vaccine beginning with 50 million killed organisms. These injections were continued for the next 5 weeks (until January 15th), being given at 3- to 4-day intervals and up to 300,000,000 killed organisms per injection. The febrile reaction was poor, the highest temperature attained being 100.2°F. Systemic reaction was severe and characterized by severe chills, headache, and depression. In spite of these measures, the iridocyclitis of the left eye had become worse, and vitreous opacities and macular edema had appeared in the left eye, with a drop in vision to 20/70, J3, uncorrectable. An active, acute iridocyclitis had also developed in the right eye. On February 1, 1944, 100,000 units of penicillin dissolved in 1,000 c.c. of normal saline were given by continuous intravenous drip, and on the following two days 100,000 units of penicillin were administered daily by intramuscular injection every 3 hours day and night.

On February 4th, the day penicillin therapy was stopped, the vision in the left eye had improved from 20/70 to 20/30, and the cells had almost disappeared from the anterior chamber and retrolental spaces of both eyes. One week later the vision in this eye had slipped to 20/40−4 with recurrence of cells in both eyes. Good pupillary dilations and hot compresses had been maintained during this period. On February 8th, treatment with penicillin as local eye drops was begun (1 c.c. per 2,500 units, made up in normal saline). These drops were given every 2 hours day and night for 2 days, but no improvement in the macular picture or in the vision of the left eye ensued. There was, however, some clearing of cells in the anterior chamber of each eye following this therapy.

On February 10th, the patient was given his first treatment in the fever cabinet. Total therapeutic time 2 hours, 45 minutes at 106°F.; total elevated time 4 hours, 20 minutes. Penicillin (100,000 units) was administered by intravenous injection during this fever therapy. Visual improvement the following day was striking, the recorded vision on that day, February 11th, being 20/20 both eyes (uncorrected) as compared to 20/70 O.S. the day before. Only a few cells were present in the anterior chamber of either eye, and there was much less edema in the macula of the left eye. This patient received two more treatments in the fever cabinet: On February 16th, therapeutic time, 4 hours at 106°F.; elevation time 6 hours (100,000 units of penicillin were again given intravenously during the treatment). The vision remained 20/20 O.U. with both eyes white and with only an occasional cell in either anterior chamber until March 10th, at which time the vision of the right eye had dropped to 20/25−1 and the iridocyclitis had recurred in this eye. During the foregoing period, the patient had developed a marked local and general sensitivity to atropine. Hyoscine had been substituted, but after one week had to be stopped because of a generalized urticaria. On March 14th, he received his third treatment in the fever cabinet (therapeutic time 3 hours, 30 minutes at 106°F., elevation time 5 hours, 30 minutes) and 100,000 units of penicillin were again given intravenously during the fever treatment. On the following day, all cells had practically disappeared and the eyes remained quiet with uncorrected vision of 20/20, J1 thereafter. This patient was kept under observation for six more weeks, but there was no further evidence of recurrence.

This case presents many points of interest. We believe it probable that the etiologic factor was a sulfathiazole- and penicillin-resistant gonorrhea. The condition continued to progress with involve-

ment of the second eye in spite of fever therapy, with triple typhoid vaccine, the elimination of foci of infection, and local eye treatments. Temporary improvement of the anterior and posterior uveitis followed the intravenous and intramuscular injections of penicillin, but the condition recurred when penicillin was stopped. Some improvement of the anterior-segment disease was noted following the use of penicillin as local eye drops, but the macular lesion was not improved. Cure of the disease was rapid and permanent following the administration of adequate fever therapy in the fever cabinet. The simultaneous administration of penicillin with the fever therapy was probably of some benefit also.

CASE 5. CORNEAL ULCER. F. S., white male, aged 25 years, was admitted to the Eye Service of Billings General Hospital on July 17, 1944, because of severe pain, photophobia, and blurring of vision in the right eye of four days' duration.

Similar symptoms had been noted about two months before, and the patient had received treatment for a corneal ulcer for a period of six weeks elsewhere. There was no history of injury. Vision on admission was as follows:

O.D. 6/200, J7, correctable to 16/200, J6, with −1.75D. sph. ⊂⊃ +.50D. cyl. ax. 120°; O.S. 17/200, J1, correctable to 20/20, J1, with −1.25D. sph. ⊂⊃ +.25D. cyl. ax. 60°.

The left eye was normal. The right eye showed an active deep corneal ulcer, 3 by 3 mm. in size, located 4 mm. from the limbus at the 7-o'clock position. It extended throughout the entire thickness of the cornea. Slitlamp study showed the surrounding cornea to be infiltrated over an area of about 5 mm. A very severe secondary iritis was present, with marked blepharospasm and lid edema. Scrapings from the corneal lesion showed many white blood cells and an occasional gram-positive coccus. Treatment was instituted as follows:

1. Atropine 2 percent—2 drops in the O.D. every 3 hours. 2. Hot wet compresses to the O.D. 20 minutes every 2 hours. 3. Penicillin in normal saline (1 c.c.—5,000 units), 3 drops in the right eye every hour during the day and every 2 hours at night. 4. Penicillin in normal saline (1 c.c.—2,500 units) as local eye baths to the right eye for a period of 1 hour morning and evening. (The contact eye cup was used for this purpose.) 5. Complete survey for foci of infection.

By July 24th, the ulcer took no further stain with fluorescein, and the eye was much more comfortable; however, it remained red and photophobic and some lid edema persisted. The corneal infiltration surrounding the ulcer had cleared, but the original deep ulcer, on slitlamp study, still appeared active under the epithelium which covered it. The appearance suggested a deep corneal abscess which had healed on the surface. It was difficult to maintain good dilation of the pupil even with 2-percent atropine, 2 drops every 2 hours. A general survey of the patient had the following results:

Blood seriologic findings and blood count normal; urinalysis normal; X-ray studies of the chest, sinuses, and teeth, negative. The tonsils were surgically absent. Prostatic examination revealed a chronic nonspecific prostatitis with 40 to 50 white blood corpuscles present in each high-power field. The prostatis was treated by gentle massage at weekly intervals.

Fever therapy was advised and instituted on July 26th. Therapeutic time, 2 hours at 104.5°F.; elevation time 3 hours, 10 minutes. *July 28th.* Therapeutic time 2 hours, at 104.4°F.; elevation time 3 hours. *August 3d.* Therapeutic time 2 hours, at 105.4°F.; elevation time 3 hours, 30 minutes. *August 8th.* Thera-

peutic time 2 hours, 5 minutes, at 104.4°F.; elevation time 3 hours, 10 minutes. *August 11.* Therapeutic time, 2 hours, at 105.4°F.; elevation time 3 hours, 15 minutes.

During this period of therapy atropine and hot compresses were continued. Response to fever therapy in this case was most gratifying. The eye became white and quiet at once. The deep corneal infiltrate was rapidly absorbed. The lid edema subsided, and the secondary iritis and photophobia disappeared. The ulcer remained solidly healed. Atropine was discontinued on August 17th, following which the eye remained quiet. Vision with correction on August 30th was: O.D. 20/20−3, J1, with −2.25D. sph. ⌯ +.75D. cyl. ax. 128°.

Impression. The corneal ulcer was controlled and superficial healing attained with penicillin therapy, atropine, and hot compresses. The deep corneal infiltration, secondary iritis, and congestion of the globe, did not subside until fever therapy was given.

Case 6. Iridocyclitis. E. B. J., aged 23 years was admitted to the Eye Service, Billings General Hospital, on April 27, 1944, because of severe pain, photophobia, and some blurring of vision of the right eye of one week's duration. Vision on admission was: O.D. 20/20−3, blurred, O.S. 20/20.

Examination showed an acute iridocyclitis of the right eye, with marked edema of the lids. The iris was two-thirds dilated and irregular because of posterior synechiae (atropine had been instilled prior to the patient's admission here). Slitlamp study showed numerous K.P. The aqueous was filled with nonmoving cells suspended in a gelatinous exudate. The iris was muddy and engorged. The lens was clear and the fundus normal. The ocular tension was 15 mm. Hg (Schiøtz). Local treatment instituted consisted of 10-percent neosynephrin drops, one in the eye three times daily, together with atropine 2-percent drops, two every three hours and hot wet compresses for 20 minutes, every two hours.

Fever therapy was given as an emergency, for it was feared this patient might develop a secondary glaucoma from obstruction of the iris angle with exudate and cells from the anterior chamber. This therapy was administered as follows:

April 27th. Therapeutic time 1 hour, 40 minutes, at 105.6°F.; elevation time 2 hours, 45 minutes. *April 28th.* Therapeutic time 2 hours, 5 minutes, at 105.4°F.; elevation time 3 hours. *May 1st.* Therapeutic time 2 hours, at 105.8°F.; elevation time 3 hours. *May 5th.* Therapeutic time 2 hours, 5 minutes, at 105°F.; elevation time 3 hours, 30 minutes.

Sulfadiazine and sodium bicarbonate, of each 1 gram, were administered every 3 hours for 4 doses preceding the first two fever treatments. Because of the development of a mild sulfadiazine urticaria, the chemotherapy was omitted in the other two treatments. Response to fever therapy in this case was spectacular, all lid edema had disappeared on the day following the first fever elevation. In addition, the eye had become free of pain and full pupillary dilation had been secured. Slitlamp study on that day showed a marked clearing of the aqueous with cells much fewer in number and actively moving in the convection currents.

Following the completion of fever therapy, the general survey for foci of infection was carried out. Some chronically diseased tonsils were removed and a mild nonspecific prostatitis was cured by periodic massage. Convalescence was uneventful with no evidence of recurrence of the iridocyclitis.

CASE 7. PENETRATING FOREIGN BODIES INTO THE VITREOUS CHAMBER. G. W. J., aged 23 years, was admitted to the Eye Service, Billings General Hospital, on April 27, 1944, for treatment of a retained metallic foreign body in the left eye, accidentally incurred three days previously. Vision was: O.D. 20/20, J1; O.S. light perception with faulty light projection. X-ray studies and localization showed the foreign body to be 4½ by 2 by 2 mm. in size, lying behind the lens in the inferior nasal quadrant of the globe. The wound of entry through the ciliary body in the temporal quadrant at the 3-o'clock position, had been closed at another hospital. The lens was clear. The vitreous was filled with blood, and no red fundus reflex could be made out. The foreign body was removed with the hand magnet on April 28th, through a peripheral iridectomy at the 9-o'clock position. Fever therapy was begun on the day of operation and continued as follows:

April 27th. Therapeutic time 1 hour, 30 minutes, at 103°F.; elevation time 2 hours, 35 minutes. *April 28th.* Therapeutic time 1 hour, 30 minutes, at 104.3°F.; elevation time 3 hours, 15 minutes. *May 1st.* Therapeutic time 2 hours, at 104.4°F.; elevation time 3 hours, 15 minutes. *May 4th.* Therapeutic time 2 hours, at 104.4°F.; elevation time 3 hours, 10 minutes. *May 6th.* Therapeutic time 2 hours, at 104.2°F.; elevation time 3 hours, 15 minutes. *May 12th.* Therapeutic time 2 hours, at 105°F.; elevation time 3 hours, 30 minutes.

Fever therapy was instituted as an emergency in this case because of the fear of intraocular infection. Two cilia carried into the vitreous chamber were extruded through the wound of entry and removed on May 10th and 17th, respectively. In spite of the fact that these cilia had been carried into the interior of the globe by the foreign body, this eye remained entirely quiet, white, and free of pain.

On May 19th a mild, quiet iridocyclitis was noted on slitlamp examination. Vision in the eye had been lost because of the massive vitreous hemorrhage first noted on the day of admission. The eye was enucleated on May 20, 1944, because of the fear of sympathetic ophthalmia and because the vision of the eye was obviously hopelessly lost because of vitreous hemorrhage and retinal detachment. The pathologic report on this eye showed massive vitreous hemorrhage with retinal detachment and a chip of paint (chrome green) imbedded in the retina near the optic disc. Loss of the eye obviously cannot be charged to the failure of fever therapy. This case is presented for two reasons:

(1) To show that fever therapy in the fever cabinet can be safely given on two successive days. (2) This eyeball remained white and quiet and free of pain following the injury and subsequent surgical removal of a metallic foreign body in spite of the presence of two cilia in the vitreous chamber for 16 and 23 days, respectively, and a particle of paint imbedded in the retina. We believe that the fever therapy played a role in keeping the eye comfortable, quiet, and free of suppuration.

CASE 8. RETROBULBAR NEURITIS, ACUTE, RIGHT, CAUSE UNKNOWN. N. J. R., a white corporal, aged 26 years, was first seen in the Eye Out-Patient Department at Billings General Hospital on July 7th, because of a sudden onset of "blindness" in the right eye and pain behind the eye on ocular movement. He stated that this had occurred about five days previously. Vision was: O.D. 2/200 not correctable; O.S. 20/200 correctable to 20/50.

This patient had worn glasses since childhood for the correction of a high degree of compound hyperopic astigma-

tism and a moderate right convergent strabismus. The right eye had been "straight" for the past 10 years. He stated that the vision had never been corrected to better than 20/70 O.D. and 20/50 O.S. Refraction under homatropine on July 7th was:

O.D. +5.00D. sph. ⊂ +1.00D. cyl. ax. 75° = 2/200; O.S. +5.00D. sph. ⊂ +.75D. cyl. ax. 120° = 20/50.

Both eyes were externally and internally normal. Peripheral field studies were normal. Central field studies showed an 8-degree absolute central scotoma, O.D. A diagnosis of retrobulbar neuritis was made. A general survey revealed no evidence of foci of infection in the mouth, throat, nose and sinuses, or prostate. The blood-serology, blood-sugar, and sugar-tolerance tests were negative. A careful neurologic examination for evidence of multiple sclerosis was entirely negative on two occasions. The patient did not use alcohol or tobacco.

He was treated in the Out-Patient Department for one week. This treatment consisted of thiamin 250 mg. daily by intravenous injection, and 10 mg. three times daily by mouth, and nitranitol 0.25 grain by mouth morning and evening.

Because there was no improvement in visual acuity after six days, the patient was hospitalized, so that fever therapy might be administered as follows:

July 15th. Therapeutic time 2 hours, 5 minutes, at 104.6°F.; elevation time 3 hours, 10 minutes. *July 19th.* Therapeutic time 2 hours, at 104.2°F.; elevation time 3 hours, 20 minutes.

The visual acuity with correction on the day following the first fever treatment had improved from 2/200 to 20/80. Following the second fever therapy, this had further improved to 20/70. No further improvement in acuity was noted and the patient stated the acuity was then as good as it had ever been. It was our opinion that the partial residual amblyopia was probably from disuse, an incident of his strabismus in childhood and high hyperopic refractive error.

Conclusion

Artificial-fever therapy is a safe and certain method of treatment by which therapeutic temperature elevations can be easily attained with a minimum of discomfort to the patient. It has many advantages over triple typhoid vaccine. In ophthalmology excellent results have been attained with short treatment periods of not over 105°F. for two hours. When available it should be considered the method of choice in those diseases of the eye in which adequate and repeated fever therapy may be a sight-saving measure.

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SOME OBSERVATIONS ON DIVERGENT STRABISMUS WITH ANOMALOUS RETINAL CORRESPONDENCE*

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Strabismus incongruus was first described by Johannes Müller,[1] although exactly what he regarded as incongruous strabismus is a little difficult to understand. The type of strabismus to which he referred was apparently congenital and incurable, depending upon the difference in the position of the identical points of the retinas of both eyes from a subjective standpoint, the identity in the two eyes belonging to different meridians with the central point in one eye corresponding to an identical point in the other eye which is removed from the central point. At the same time, however, by the use of pressure phosphene he gave an accurate description of corresponding retinal points, which is apparently the first reference to such points. The use of local pressure on the eyeball to produce a luminous effect has been known since the time of Aristotle. Hering,[2] in 1863, by the use of afterimages found a similar localization of corresponding retinal points.

Donders[3] was somewhat confused by Müller's statements and believed that he referred only to an apparent strabismus with either a positive or a negative angle. However, Alfred von Graefe[4] described a very classical case of incongruence of the retina through displacement of the optic nerve. This he described as due to the macula, together with the optic nerve, being strongly displaced inward. He cited, likewise, another case[5] of true incongruence of the retina in which the macula is said to have occurred at the nasal side of the optic nerve in one eye. Furthermore, von Graefe discussed the subject somewhat in detail in a clear manner[6] although Arlt[7] was still somewhat confused by his description. He believed, however, that these were not true incongruities of the retina but asymmetrical development of the two halves of the eye. Both Donders[8] and Von Jaeger[9] believed these to be cases of apparent strabismus without actual deviation of the visual axes.

Duane,[10] in discussing the subject of retinal incongruity in general, gives to von Graefe credit for the original discovery. In 1842, Pickford[11] had previously described the first instance of a true retinal incongruity, later to be followed by a large number of similar observations. Duane points out the fact that retinal incongruity is frequently associated with horror fusionis, which von Graefe called "Antipathy to single vision," and cites the close relationship between incongruity and horror fusionis. In a review of 42 cases of incongruity, he cited 9 which were exotropic and 5 others which were exotropic with vertical deviation. One case given in detail cites the case of a boy, aged 18 years, who had had a divergent strabismus since the age of two years. Operations had been performed upon one eye when he was 12 years old and upon both eyes when he was 16. There was a resulting diplopia and marked asthenopia and only 3 degrees of objective deviation. Images were fused with the amblyoscope, however, only when the tubes were converged 30 to 40 degrees. Correction of the refractive error caused disappearance of the diplopia and asthenopic symptoms.

Concerning divergent strabismus, Bielschowsky[12] pointed out that, while perfect binocular vision and depth perception

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might be present even with good fusional amplitude during latent periods of divergent strabismus, diplopia is absent during the manifest periods of squinting. Likewise, if diplopia images are produced by any one method, they will not be crossed but will show an anomalous retinal correspondence approximately equal to the divergent position of the eyes. Prisms, base in, produce diplopia. With vertical prisms the objects are seen one directly above the other or with only a very slight lateral displacement. In the afterimage test of Hering, the vertical image belonging to the right eye is displaced more or less to the right of the center of the left afterimage. One gains the impression from his description that the correspondence in such instances is normal during the latent period and anomalous if the squinting is manifest. He feels that in every case of constant divergent strabismus an anomalous correspondence will be found, with alternate suppression of the squinting eye. Likewise, he warns, horror fusionis frequently occurs and should be looked for in every case of alternating divergent strabismus. Following surgical correction of the strabismus, homonymous diplopia is likely to be present and to persist for a longer or shorter period of time until there is orthophoric suppression or binocular vision is reëstablished.

Concerning the operative correction of such cases, he described in detail one case. He states: "There are cases of divergent strabismus, fortunately rare, which baffle the doctor in spite of the greatest care and experience and the greatest skill as to operative technique." A boy, aged 5 years, with 30-degree divergent strabismus and poor convergence underwent an operation in which advancement of both internal recti combined with recession of both external recti was performed. A 20-degree divergence remained. Three years later advancement of both internal recti was repeated and the divergence reduced to 12 degrees, which increased to 26 degrees within the next month. "In addition to the ordinary sutures, auxiliary double-armed needles were passed through the body of the muscles and fastened beyond the vertical meridian both above and below." The immediate effect was excellent, but divergence developed again and increased to 30 degrees within three months. Adduction was poor, both before any surgical attempt was made and before the third operation was attempted. Bielschowsky believed that the defect might have been due to some congenital anomaly, which defect he was never able to discover, even after the most careful search, and he was unable to account for the very unsuccessful result. He does not state, however, whether or not anomalous retinal correspondence was present.

Concerning development of anomalous correspondence Bielschowsky[13] states that little is known except that investigators agree that it seldom occurs in squint arising after the sixth year. Exceptions occur, however, in some individuals with high exophoria in whom a latent squint becomes a manifest divergent strabismus but reveals no evidence of diplopia. When double images are produced by the red glass and prisms, there is an homonymous diplopia showing the characteristics of anomalous retinal correspondence adapted to the angle of the strabismus. He feels, likewise, that, because of the unstable nature of the anomalous correspondence, the time-consuming effort to determine its presence or absence is a matter of questionable value. It is entirely within the realm of possibility that the correspondence in the aforedescribed, very unsuccessful case of divergent strabismus was never determined.

The question of anomalous retinal correspondence in divergent strabismus has

received little or no attention except by Duane and Bielschowsky. Howe,[14] Savage,[15] and Worth[16] do not mention the subject. On the other hand, Chavasse[17] states that normal sensory correspondence is particularly common in divergent strabismus, especially if intermittent. This is also true even if there is an insufficiency of convergence at an early date. He does subscribe, however, to the remark of Bielschowsky that anomalous retinal correspondence may occur in older individuals in whom a latent exotropia may become a manifest divergent strabismus. He cites also one case[18] of a girl, aged 12 years, who had alternating divergent strabismus with good convergence, who had at times a normal and at other times an anomalous retinal correspondence. Duane[19] found and admitted cases of divergence excess, in whom the convergence is normal in spite of the high exophoria.

The subject of divergent strabismus apparently involves two definite classes of cases. The first comprises those individuals who at an early age have a spasm of one external rectus when the eyes are focused upon a distant object. This type of strabismus is definitely intermittent in character and remains latent most of the time. Strabismus is no more pronounced nor frequent when the child is fatigued. Spasms of one or the other eye outward may occur at any time of the day, the strabismus disappearing and binocular fixation assumed if the child's attention is focused upon the defect. The movement of recovery in producing binocular fixation is brought about either by a blinking of the eyes or a voluntary fusional effort. The strabismus remains intermittent and becomes manifest only when the individual is relaxed. Diplopia is generally absent. Should the deviation reach the degree at which voluntary fusional efforts are insufficient to produce binocular fixation for distant objects, it may still be produced for near objects. In many instances an individual may have an intermittent or even a constant divergent strabismus for distance and binocular fixation at one-third meter. Asthenopic symptoms occur when the eyes are used for reading or other close work, are apparently due to the extremely high exophoria, and may be present in spite of a normal convergent near point.

Convergence usually remains intact and oftentimes normal in spite of high degrees of deviation for both distant and near objects. One individual, who had a constant divergent strabismus of approximately 70 arc degrees alternating in character, was able to produce binocular fixation for near by the aid of a looking-glass. I believe that the ability to produce binocular fixation for near, in spite of a high degree of deviation for distance, is the most important single test for the successful outcome following surgical intervention. Thus, an individual may at times have an anomalous correspondence adapted to the angle of the deviation, but the anomalous correspondence is not constant and may be varied according to the state of the muscle balance itself. Should diplopia occur in such cases following surgical intervention, it is due to a temporary overcorrection or lack of external rotation and is definitely homonymous in character. I have never seen it persist except for a short period of time.

I have not failed to find a successful surgical result in any individual who is able to produce binocular fixation, spontaneously or with voluntary fusional effort, in any case of divergent strabismus. It would appear that this strabismus arises as a pure divergence-excess anomaly, and, although the exophoria for the near point is increased as a result of anatomic changes in the muscles, produced by the spasms and relaxations of the external rectus, the convergence func-

tion itself remains intact and is not ultimately broken down by the divergence excess. Davis[20] has reported an excellent example of this type of anomaly. It would appear that a purely divergent type of anomaly does not have the deleterious effect upon the fusion center that is true in the case of the convergent anomalies.

The second class comprises a much more infrequent type, in which the strabismus is constant in character in the absence of voluntary fusional efforts to produce binocular fixation. Amblyopia may be and more frequently is present than in the first type described. Some degree of hypertropia is generally present, but no true cases of double hyperphoria were found in this type of anomaly. The deviation usually begins shortly after birth or even as late as the age of adolescence. The amount of deviation is fairly constant, both for distance and near, and is, in the vast majority of cases, greater than or equal to the amount of deviation for distance. Convergence in four cases out of five is faulty. I do not believe that the convergence function is paralyzed, for it can be greatly improved by exercise, but it does not approach the normal convergent power. The anomalous correspondence is constant in that it is never normal and then anomalous. The fusion is extremely poor; sometimes first-degree fusion may be present but oftentimes even this is lacking, which in all probability accounts for the discrepancy between the findings of the correspondence on the synoptophore, the red glass, and the afterimage test. I believe that the former are more conclusive than the latter as an indication for surgical correction. It is in this group of cases that surgical intervention results either in a gradual increase in the amount of deviation, until the original amount is assumed, or in a constant asthenopia which is extremely difficult to relieve.

I have attempted in every case to eliminate all possibilities of either traumatic or infectious involvement of the convergent center and was surprised to find that even small children, who had definite evidence of injury to the convergent center, either as a result of trauma or encephalitis, did not show the usual characteristics of anomalous retinal correspondence. The visual factor in all probability plays an important part.

In 4 cases out of 15 there was definite amblyopia, which is a high percentage as far as divergent strabismus itself is concerned. Likewise, in the only case observed, in which the anomalous correspondence disappeared spontaneously, it was apparently dependent upon an increase in the visual acuity rather than upon any change in the muscle balance. In those cases in which the patient was submitted to surgical treatment the immediate outcome of the surgical intervention was entirely satisfactory, but the deviation increased within a short period of time. The anomalous correspondence was always adapted to the angle of deviation; it decreased with surgical intervention, and increased simultaneously with the deviation itself. In the course of a month or two it usually assumed its original charaacteristics and amount.

It is interesting to note that in those cases in which there was a combined vertical deviation the incongruity of the images was present sometimes for the lateral and sometimes for both deviations. Fusion, however, was so poor in every instance that diplopia did not occur as a result of the surgical treatment.

In some instances, in which divergent strabismus has resulted from a previous convergent strabismus at some time after the age of puberty, an anomalous correspondence adapted to the angle of the deviation is sometimes found. In others, the correspondence is normal, and diplopia occurs as soon as one eye diverges. The same is likewise true in those cases

in which a divergence has resulted from the surgical overcorrection of a convergent strabismus. In these instances, however, the anomalous correspondence rapidly disappears following the surgical correction of the divergent strabismus. Convergence exercises would seem to produce more beneficial effects than any other type of therapy, but it is not believed that the improvement is maintained, even though the correspondence is adapted to the angle of the strabismus as the improvement results. It is not felt that convergence exercises, unless maintained constantly, would prevent the strabismus from assuming its original angle of deviation.

In a small group of cases there is apparently a type of divergent strabismus that arises as a result of divergence excess with an apparently constant and unvariable anomalous retinal correspondence, yet which has good convergence and sometimes binocular fixation for the near point of one-third meter. When, however, any attempt is made to correct the strabismus, either by the use of prisms or by surgical intervention, an immediate diplopia or constant asthenopia results. This is well illustrated by case 3 in group 2 of this report, and also by the similar case reported by Duane.[21] The nonsurgical treatment would seem to be quite as unsatisfactory as surgery itself. Subjective symptoms are generally lacking. A decrease in the amount of deviation or a change in the type of the correspondence does not result from the use of orthoptic exercises.

The four surgical cases here reported in group 1, in which the strabismus had a tendency to resume the original angle of deviation following surgical correction, would seem to correspond in almost every detail to the case reported by Bielschowsky. It is my belief that in these cases the faulty functioning of the convergence center is the primary cause of the poor surgical result. These must be contrasted with case 3, group 2, and the similar case reported by Duane, in which there was a successful correction of the deviation itself but an anomalous correspondence adapted to the previous angle of deviation. It is possible that over a period of years correspondence might return to normal, as there was every evidence in case 3, group 2, that the anomalous correspondence was gradually becoming more normal as evidenced by the fusion of images when the tubes were converged from 15$^{\Delta}$ to 40$^{\Delta}$, six years after the last operative procedure was performed.

Group 3 represents definite instances of horror fusionis. The individual in whom horror fusionis might possibly be present has a condition for which every ophthalmic surgeon should be constantly on the alert. The classical method of diagnosis, as described by von Graefe, in which it is impossible to produce fusion of the images with any correction of the deviation and a marked increase in the deviation itself with slight overcorrection, needs no further emphasis. Both the correction of the deviation itself with prisms and by surgical correction results in a most distressing type of asthenopia or diplopia. As stated previously, the deviation itself generally produces no cosmetic defect. Binocular fixation and binocular vision are likely to be present at one-third meter, while constant deviation of the visual axes from six meters to infinity is often present. Very great care in the correction of the refractive error usually results in the complete and total cessation of all the subjective symptoms, and the condition itself would seem to be dependent upon a defect in the sensorial as much as upon a defect in the motor apparatus and the various pathways.

It might be argued that the three cases represented in group 2 belong in the definite category of horror fusionis with

a high degree of deviation. I do not believe, however, that they can be placed in this group, for there was not the least attempt on the part of any one of these individuals to fuse images with a partial or total correction of the deviation present. Even the slightest correction of the deviation produced a constant and insurmountable diplopia. In the first two cases of this group the convergence function was carefully studied and found to be normal. In the other instance the convergence function was found to be satisfactory following surgical treatment elsewhere, and it is assumed that it was good or normal before surgical intervention. Although the convergence function may be fairly good in horror fusionis, it does not seem possible to classify these cases in that group.

The following record is the report of 22 cases of divergent strabismus which have been followed over a period of months or years, and from which certain deductions are drawn. The cases fall roughly into the three main groups previously described.

The first group of 15 cases comprises those with constant divergent strabismus of small or high degree with total anomalous correspondence, poor convergence, and poor fusion, in which it seems impossible to correct the divergence medically or surgically. The age of onset in each instance was early in life, at or shortly after the age of puberty. In one case the onset was at 22 years of age, while in another it was thought to be present from birth. Heredity apparently played no prominent part except in three patients, who were said to have had relatives with a similar condition. Amblyopia was present in four cases, with vision of 20/60, 20/70, 20/30, and 20/200 in the amblyopic eye with correction of the refractive error. The amount of deviation was approximately equal for distance and near, or slightly greater for near in every instance. In 4 of the 15 cases there was an associated hyperphoria that ranged from 2$^{\Delta}$ to 18$^{\Delta}$. The hyperphoria was always concomitant. In some of the other cases the presence or absence of hyperphoria was impossible to determine subjectively. The amount of deviation varied from 18$^{\Delta}$ to 90$^{\Delta}$, deviation of 40$^{\Delta}$ to 50$^{\Delta}$ being the usual amount.

The correspondence was checked in each instance by the use of the red glass, the synoptophore, vertical prisms, and the afterimage test. The anomalous correspondence was total in 12 cases and partially total in three. In one instance there were 90$^{\Delta}$ objectively and 12$^{\Delta}$ subjectively; in another 20$^{\Delta}$ objectively, 4$^{\Delta}$ subjectively; and in another 18$^{\Delta}$ objectively and 10$^{\Delta}$ subjectively. The convergence function was poor or nil in every instance. There were no instances in which a definite paralysis either of the lateral or vertical recti could be demonstrated, and there was no history of a previous traumatic or infectious paralysis of convergence function. None of the cases gave previous history of original convergent strabismus. The fusion was poor in all cases, although sufficiently good in one instance to measure the subjective deviation by the use of the phorometer. In some instances the fusion was so poor that the afterimage test was not reliable. In these instances the individual had a tendency to form a more or less perfect cross with the afterimage test, whereas with the synoptophore or red glass there was total anomalous correspondence. In one instance the vertical portion of the cross was definitely oblique, indicating oblique involvement, although the fusion was so poor as to make a subjective measurement of the vertical deviation impossible. The afterimage test would, however, seem to be a very valuable adjunct in testing the nature of the correspondence. Diplopia was not

TABLE 1

DATA ON 22 CASES OF DIVERGENT STRABISMUS

Patient Sex/Age	Symptoms	Onset	Heredity	Vision R.E.	Vision L.E.	Objective Deviation	Subjective Deviation	Convergence	Fusion	Binoc. Fixation	Correspondence	Treatment	Results
GROUP 1													
1 C E F 45	None Subj.	Birth	Not known	20/20	20/25	70Δ 78Δ R Eye	None +	Nil	None	None	Anomalous total	Surgery	No imp.
2 R B M 13	None Subj.	2 yrs.	None	20/60	20/20	37Δ 44Δ 2Δ RH	None +—	Nil	1°	None	Anomalous total	Surgery	No imp.
3 E M M 16	None Subj.	Early childhood	Not known	20/20	20/20	55Δ 57Δ 8Δ L H	None ⊢	Nil	1°	None	Anomalous total	Surgery Conv. Exer.	Some imp.
4 A M F 33	None Subj.	16 yrs.	None	20/20	20/20	18Δ 30Δ	10Δ 8Δ	Poor	1°	None	Anomalous partial	None	
5 A S F 10	None Subj.	6 yrs.	Cousin similar	20/20	20/20	20Δ 30Δ	O Synop. ⊣	250 mm.	None	None	Anomalous total	Conv. Exer.	Some imp.
6 J M M 27	None Subj.	10 yrs.	None	20/20	20/20	20Δ 20Δ	O None +−	Poor	1°	None	Anomalous total	None	
7 B P M 16	None Subj.	Childhood	Mother similar	20/20	20/20	70Δ 70Δ	None	None	None	None	Anomalous total	None	
8 A H F 29	None Subj.	11 yrs.	None	20/15	20/20	90Δ 90Δ	12Δ ⊣	None	None	None	Anomalous partial	None	
9 D R M 12	None Subj.	1 yr.	None	20/20	20/20	32Δ 35Δ	None	None	1°	None	Anomalous total	None	
10 E F F 33	None Subj.	4 yrs.	Not known	20/40	20/20	50Δ 50Δ 16 L H	None ⊢	None	None	None	Anomalous total	Surgery	Slight imp. 40Δ 42Δ
11 M M F 19	Asthenopia	9 yrs.	Sister said to be similar	20/30	20/20	25Δ 50Δ	None ↾	Poor	1° only	None	Anomalous almost total	Refraction	Relief of symptoms
12 B B F 22	Asthenopia	22 yrs.	None	20/20	20/200	0Δ 15Δ	None synop.	Nil	1° only	Dis. Yes	Total 13°	Refraction	Spontaneous recovery
13 F M M 16	Headache	Not known	None	20/20	20/20	20Δ 20Δ 5Δ L H	None phorometer	Poor	1° only	None	Anomalous total	Refraction	Relief of symptoms
14 P H F 13	Headache Asthenopia	12 yrs.	Aunt has div. exc., strab.	20/20	20/20	10Δ 20Δ	3Δ 2Δ	350 mm.	2°	None	Anomalous almost total	Refraction	Relief of symptoms
15 G A S 21	None subj.	20 yrs.	None	20/20	20/20	30Δ 30Δ	None red glass	None	None	None	Anomalous total	None	

TABLE 1—*Continued*

Patient Sex/Age	Symptoms	Onset	Heredity	Vision R E	Vision L E	Objective Deviation	Subjective Deviation	Convergence	Fusion	Bin. Fixation	Correspondence	Treatment	Results
GROUP 2													
16 T S M 14	Asthenopia	2 yrs.	Mother conv. exc.	20/20	20/20	24^{Δ} 12^{Δ}	2^{Δ} SO 2^{Δ} SO	Good	1° only	For 13" ?	Anomalous total	Refraction orthop. exer.	Relief of symptoms
17 R S M 14	Asthenopia	2 yrs.	Mother conv. exc.	20/20	20/20	26^{Δ} 12^{Δ}	2^{Δ} SO 2^{Δ} SO	Good	1° only	for near ?	Anomalous total	Refraction Orthop. exer.	Relief of symptoms
18 E E B M 34	Asthenopia	Childhood	None	20/20	20/20	5^{Δ} XO	40^{Δ} SO	Good Conv. spasm?	1° only	Near ?	Anomalous	Surgery Orthop. exer. Refraction	Slight imp. in symp.
GROUP 3													
19 B K F 20	Asthenopia	18 yrs.	None	20/20	20/20	12^{Δ} 22^{Δ}	6^{Δ} 16^{Δ}	Poor	1° only No amplitude	Near ? 13" ?	Anomalous partial	Refraction	Relief of symptoms
20 G McR F 29	Asthenopia	Adolescence	None	20/20	20/20	20^{Δ} 20^{Δ} 3^{Δ} R H	12^{Δ} 12^{Δ}	Poor	1° only No amplitude	Near ? 13" ?	Anomalous partial	Refraction	Relief of symptoms
21 H J F 38	Marked asthenopia	Adolescence	None	20/25	20/20	20^{Δ} 20^{Δ}	1^{Δ}SO 2^{Δ}SO	Good	Good No amplitude	13" Yes Dis. ?	Anomalous total	Refraction	Partial relief
22 T H F 20	Asthenopia Headache daily	18 yrs.	None	20/20	20/20	25^{Δ} 25^{Δ}	8^{Δ} 8^{Δ}	Good	Poor No amplitude	Dis. ? 13" Yes	Anomalous partial	Refraction	Complete relief

present in any instance, although at times it might be induced by the use of the red glass and prisms, base in, to correct the deviation. In such cases the diplopia was always incongruous in nature. None of these individuals was able to produce binocular fixation for distance or near vision, either with spontaneous or voluntary fusional effort.

Three methods of treatment were instituted in these cases for the relief of the deviation and improvement of the cosmetic defects: (1) Orthoptic training; (2) convergence exercises; (3) surgery. In each instance the fusion was so poor that the orthoptic training proved to be of little or no value. Convergence exercises, when it was possible to use them, temporarily reduced the amount of deviation present, but the deviation increased as soon as the exercises were discontinued. In one instance the exercises were continued because of the presence of asthenopia and an increase in the deviation as soon as the exercises were discontinued. Four cases of this group were treated surgically, all of which were unsuccessful in the outcome.

Case reports

Case 1. E. M., a girl, aged 16 years, developed a divergent strabismus early in childhood. She was a ward of the state, and no information could be obtained about her heredity or early childhood. She had worn glasses since 1936, although the refractive error was practically nil. There was a deviation of 55$^{\Delta}$ for six meters and 57$^{\Delta}$ at one-third meter, combined with 8$^{\Delta}$ of left hypertropia. With the synoptophore the soldier was put in the house at zero degrees, making total anomalous correspondence. The afterimage test also showed total anomalous correspondence.

On September 18, 1940, the right external rectus was recessed 2 mm.; the right internal rectus resected 4 mm. On October 30, 1940, the deviation was 58$^{\Delta}$ for distance and at one-third meter. January 1, 1941, the deviation was 44$^{\Delta}$ of exotropia for distance and 44$^{\Delta}$ of left hypertropia at one-third meter; January 4, 1941, 50$^{\Delta}$ of exotropia, 3$^{\Delta}$ of left hypertropia for distance and near. December 16, 1941, at 2½-mm. recession of the left external rectus and a 5-mm. resection of the left internal rectus were performed. The immediate effect on January 7, 1942, was 18$^{\Delta}$ of exotropia for distance and 23$^{\Delta}$ of exotropia for near, which increased by February 25th to 26$^{\Delta}$ for distance and 43$^{\Delta}$ at one-third meter. At this time convergence exercises were instituted which achieved an immediate improvement to 15$^{\Delta}$ of exotropia for distance and 26$^{\Delta}$ diopters for near. These values remained the same for several months under exercise, but gradually increased as soon as the exercises were discontinued. Binocular fixation could not be induced for either distance or near vision.

Case 2. R. B., a boy, aged 13 years, had had a periodic divergent strabismus, limited to the right eye, since the age of two years. The right eye was also amblyopic, having a vision of 20/60 both corrected and uncorrected. There was a deviation of 34$^{\Delta}$ for distance and 48$^{\Delta}$ for near, with approximately 2$^{\Delta}$ of right hyperphoria with the red glass. There was total anomalous correspondence with the red glass and also with the afterimage test. Convergence was nil. The fusion was so poor as to make the use of the synoptophore unreliable. There was partial suppression with the red glass and occasional diplopia with correcting prisms.

On April 8, 1942, the right external rectus was recessed 3½ mm., and the right internal rectus resected 4 mm., with resulting correction of 14$^{\Delta}$ for six meters and 18$^{\Delta}$ at one-third meter. The convergence function was not improved and images were still superimposed at zero

degrees. Diplopia was not present. In February, 1943, the deviation had increased to 22$^{\Delta}$ at six meters and 33$^{\Delta}$ at one-third meter. Some slight degree of right hyperphoria or a very slight double hyperphoria was still present. The anomalous correspondence was not changed by the surgical procedure, and the deviation was gradually increasing.

Case 3. C. E., a woman, aged 45 years, had a divergent strabismus of the left eye which had been present from birth. The vision of the right eye was 20/20, left eye 20/25, with the right eye fixating more or less constantly. The deviation measured 70$^{\Delta}$ for six meters and 78$^{\Delta}$ for one-third meter. Concergence was nil. In the afterimage test there was normal correspondence with a more or less perfectly formed cross. Fusion was very poor and diplopia was induced with difficulty.

On January 29, 1942, a complete tenotomy of the left external rectus and a 6-mm. resection of the left internal rectus muscle were performed. The immediate effect of this operation was to reduce the deviation to 50$^{\Delta}$, a 20$^{\Delta}$ improvement as a result of the surgical procedure. The condition remained practically unchanged during the next week, or perhaps with a slight increase in the amount of deviation. The correspondence was again checked and found to be what was considered a perfect cross on the afterimage test. With the red glass and prisms, however, there was total anomalous correspondence. Fusion was so poor that simultaneous macula perception could not be demonstrated on the synoptophore.

On December 22, 1942, the following surgical procedure was carried out: The left internal rectus was resected 3 mm. and advanced 1½ mm. The right medial rectus was resected 5 mm. and advanced 1½ mm. The left external rectus was again freed and recessed fully to the equator of the eyeball. The immediate effect of the surgical procedure was very satisfactory in that the deviation was reduced to 10 degrees when the patient was discharged from the hospital. In January, 1943, the deviation had increased slightly to 30$^{\Delta}$ for distant and near vision, and in May, 1943, the deviation measured 45$^{\Delta}$ for both distant and near vision. The total net result of all the operative procedures had been a decrease of 20$^{\Delta}$ to 25$^{\Delta}$ in the total amount of deviation.

Case 4. E. F., a girl, aged 10 years, had had a divergent strabismus of the right eye since the age of four years. She had worn glasses which had not improved the deviation; there was no evidence of any hereditary influence as a causative factor in her condition. The vision of the right eye was 20/40, of the left eye 20/20. The deviation measured 50$^{\Delta}$ of exotropia and 16$^{\Delta}$ of left hypertropia for six meters and one-third meter. Convergence was practically nil. Both the afterimage and the red-glass tests showed total anomalous correspondence. The right vertical afterimage was 39 cm. to the left and 11 cm. above the central point. There was 16 diopters of hyperphoria in the six cardinal directions of the gaze.

In October, 1940, the right external rectus was recessed 2½ mm. and the right internal rectus resected 5 mm. The immediate effect of the operation was satisfactory, with no untoward reaction. The patient was reëxamined in February, 1941, at which time the deviation was 50$^{\Delta}$ of exotropia and 16$^{\Delta}$ of left hypertropia for six meters and one-third meter. This deviation gradually became stationary in the next few months, showing a final measurement of 40$^{\Delta}$ of exotropia and 16$^{\Delta}$ of left hypertropia at six meters and 42$^{\Delta}$ of exotropia and 16$^{\Delta}$ of left hypertropia at one-third meter—a very slight improvement from the operative procedure. No further surgery was contemplated because of the unsatisfactory result obtained.

Group 2 represents apparently a much more uncommon divergent anomaly than the first, the chief difference between the two being the state of the convergence function. In this group, which comprises only three cases, there is poor fusion, total anomalous correspondence, good convergence function, and likewise the absence of any subjective symptoms except asthenopia. Two of the cases occurred in identical twins and might be reported as a single case, as they are almost identical. As stated previously, it might be argued that these three cases are instances of horror fusionis with a higher-than-usual degree of deviation, as the convergence function was good in each instance. I do not believe, however, that they can possibly be classified as true cases of horror fusionis.

Cases 1 and 2 are those of identical twins, aged 14 years, who had had divergent strabisms since the age of two years. They had been treated since that time by glasses and orthoptic exercises. There was a gradually increasing divergent strabismus in both cases, but no subjective symptoms except asthenopia. In one—T S—the refractive error was: R.E. −1.50D. sph. ⊂⊃ −.25D. cyl. ax. 45°; L. E. −.25D. cyl. ax. 90°. The vision was equal with the left eye dominant. The deviation measured 24$^{\Delta}$ exotropia for distance and 12$^{\Delta}$ for near, with square prisms. There were two diopters of esophoria on the phorometer. Convergence was excellent. There was first-degree fusion on the synoptophore, suppression with the red glass, and total false correspondence. Diplopia was present as soon as any attempt was made to correct the divergence, which was constant for distance. At one-third meter there was binocular fixation, with a movement of recovery of either eye and normal convergence. There was normal correspondence on the afterimage test, although a slight tendency of the horizontal meridian to be tilted. No treatment was instituted, except correction of the refractive error.

In the other twin—R S—the refractive error was R.E. −25D. cyl. ax. 90°; L. E. −1.25D. sph. ⊂⊃ −25D. cyl. ax. 45°. With the square prisms there was deviation of 26$^{\Delta}$ for distance, 12$^{\Delta}$ for near, and 2$^{\Delta}$ of esophoria on the phorometer. Convergence was good. Prisms, base in, produced diplopia and, base out, produced suppression. There was total anomalous correspondence with the red glass and practically normal correspondence with the afterimage test. First-degree fusion only was present. No subjective symptoms were present when the glasses were worn constantly.

Case 3. E. B., a man, aged 34 years, had had a divergent strabismus that restricted him to the use of only one eye at a time, for at least the past 16 years. In 1935, he had had some orthoptic training from an optometrist. Later in the same year a recession of the left external rectus had been performed by one physician, and in 1936 a resection of the left internal rectus by another.

When first seen, in April, 1941, he complained of having had severe asthenopia and headache since the surgery, but he was quite free after a night of rest. As a bookkeeper he had considerable difficulty in performing his usual duties. Visual acuity was 20/20 in each eye, and there was practically no refractive error. No cosmetic defect was present, and there was no evident deviation of the visual axes. With square prisms and the screen test there were approximately 5$^{\Delta}$ of exophoria and an incongruous diplopia of approximately 40$^{\Delta}$ on the phorometer. With the synoptophore he was able to fuse when the tubes were converged from 20$^{\Delta}$ to 40$^{\Delta}$, and had no more than first-degree fusion. Diplopia was absent at all

times and suppression was present with the red glass. The convergence function was excellent but tended to be excessive rather than weak. It is possible that a definite convergent spasm was present. No treatment was instituted except the correction of a small amount of astigmatic error, although the symptoms gradually became less pronounced, and in the course of two years he was able to carry on his usual duties with much less discomfort. The incongruous diplopia seemed to be gradually decreasing, as he was able to fuse on the synoptophore at approximately 15$^{\Delta}$ whereas previously 20$^{\Delta}$ was the best that he could accomplish.

Case 3 is placed in this group because of the presence of good convergence function, as it is believed that, if the identical twins had been subjected to surgery, they would show the same characteristics as in case 3; namely asthenopia, correction of the divergent deviation, and incongruous diplopia. There is nothing of importance in the heredity of these twins, except that the mother has a convergence excess and shows approximately 2$^{\Delta}$ of esophoria for distance, 22$^{\Delta}$ of esophoria for near, but with binocular fixation at all times. There was a history at one time in the boys' mother of a severe asthenopia while going to college, occasioned by an emotional upset. These three instances seem to indicate anomalous correspondence arising in an individual, with divergent strabismus due to divergence excess. Although the condition is correctable surgically, the aftersymptoms of asthenopia and headache might not warrant the correction of the cosmetic defect in the absence of severe subjective symptoms.

Group 3 represents a series of four cases in individuals in whom there is a more or less constant deviation for distance, binocular fixation for near, with subtotal or total anomalous correspondence, and with classical findings of horror fusionis. The deviation in these cases never exceeded 28$^{\Delta}$, was greater for distance than for near vision, with good fusion and with good convergence in one instance. There was, however, an entire absence of the amplitude of fusion. Fusion was poor except in the one instance, mentioned, and in this individual there was a tendency toward diplopia when fatigued. The anomalous correspondence was either totally or partially anomalous. Binocular fixation was apparently present in each instance at one-third meter and only once at six meters. Amblyopia was not present in any instance. Any attempt to correct the total deviation was occasioned by a spontaneous diplopia, incongruous in nature, with inability to overcome the diplopia present. Symptoms of asthenopia were generally marked and greatly increased by the use of prisms, base in, for the correction of the deviation present. Meticulous care in the correction of the refractive error resulted in every instance in a complete relief of the symptoms present. In no instance was there a definite noticeable cosmetic defect. Symptoms were definitely increased with fatigue and emotional stress.

In addition to the aforementioned three groups, one case (No. 12, group 1) is reported in detail because of a spontaneous disappearance of the abnormal retinal correspondence occasioned by an improvement in the visual acuity.

B. B., a woman, aged 22 years, had been under observation since the summer of 1938, when she suffered an injury to the left eye. At this time a small pin dart pierced the cornea of the left eye near the limbus, passing through the iris and entering the lens posterior to the equator. This produced an opacity on the posterior

lens capsule and cortex, similar to that seen in cataracta complicata, with a consequent reduction in vision to approximately 20/200. This opacity on the posterior cortex gradually became stationary, and the vision improved with a −1.50D. sph. to 20/65. The refractive error of the right eye was low hyperopic astigmatism. As vision gradually improved, severe asthenopia developed. Binocular fixation for distance and a constant divergent strabismus for near were present. At this time there were 15$^{\Delta}$ of exophoria at one-third meter with square prisms, no fusion, no subjective deviation on the phorometer, total anomalous correspondence on the synoptophore, and suppression with the red glass. Images were always fused at zero degrees on the synoptophore. There was a slow but gradual change in the refractive error, which changed from −1.50D. sph. to +1.00D. sph. $\bigcirc\!\!\!\!\!\!=$ +1.50D. cyl. ax. 120°. With this lens there was 20/50−2 vision and a marked improvement in the asthenopic symptoms. In November, 1942, a little more than two years after the original injury, there were binocular fixation for distant and near vision, normal correspondence, and 12$^{\Delta}$ of exophoria, both on the phorometer and the synoptophore. As soon as the correspondence returned to normal, there was a marked cessation of all of the asthenopic and subjective symptoms in spite of the marked difference in visual acuity in the two eyes. It would seem in this instance that the visual loss was responsible entirely for the production and maintenance of the abnormal retinal correspondence, and that correction of the refractive error was the most important single factor in the reduction of the symptoms and the return to normal of the retinal correspondence.

Comments

As a result of this study of 22 cases of divergent strabismus with anomalous retinal correspondence, a division into three primary groups has been made. The first group, with constant strabismus, poor fusion, and poor convergence, is the most difficult in which to secure satisfactory results. Neither the anomalous correspondence nor the poor fusion can be regarded as more than secondary factors in the tendency of the deviation to return to its original value. Consequently, the poor converging power must be the primary factor, as both poor fusion and anomalous correspondence are found in divergent strabismus in which the deviation can be reduced to a satisfactory cosmetic result. On the other hand, I do not consider the poor convergence a paralysis, as marked improvement resulted from exercise, even though maximum improvement was not maintained. In a small series of cases, with paralysis of convergence due to either trauma or encephalitis, I was able to produce little or no improvement following convergence exercises, even though these were conscientiously continued for some months. This group also had normal retinal correspondence. One should, therefore, carefully weigh all the factors before attempting surgical correction.

In the second group, with good converging power but a constant anomalous correspondence adapted to the angle of the deviation, a satisfactory cosmetic result may be secured. On the other hand, severe asthenopia and occasional incongruous diplopia are unpleasant consequences of surgical correction. Diplopia itself is not a distressing symptom after surgery, for, in every instance encountered both personally and in the literature examined, fusion was too poor to give rise to constant diplopia. Spontaneous disappearance of the anomalous correspondence does not apparently follow surgical correction, as is usual with the

convergent type. Whether the long period of discomfort and rehabilitation which follows the surgical correction in this group is justifiable for removal of the cosmetic defect, is one question which should be decided by the individual himself.

The third group comprises the not infrequent cases of horror fusionis. These are individuals with better fusion, a moderate divergent strabismus for distant or near vision, with marked asthenopic symptoms. Diplopia may frequently be present but not annoying, even though the cosmetic defect is small or absent. Although fusion may be fairly good, the amplitude of fusion is nil, and binocular vision is not possible with any correction of the deviation. The anomalous correspondence is partial or total, and constant in amount. Correction of the deviation, either by the use of prisms or surgery, results in a marked increase in asthenopic symptoms. Meticulous care in the correction of the refractive errors should produce complete relief.

Summary

Twenty-two cases of divergent strabismus with constant anomalous correspondence have been studied from the standpoint of diagnosis and treatment. The fusion was so poor in some instances as to make the afterimage test unreliable.

From therapeutic results the cases are divided into three main groups:

1. Cases with poor convergence which were incurable, the deviation tending to assume its original amount and characteristics after surgical correction. Convergence exercises help to reduce the cosmetic defect but the improvement is not maintained.

2. Cases with good convergence in which the deviation can be corrected surgically. Severe asthenopic symptoms and incongruous diplopia are present for years after surgical correction.

3. Cases of horror fusionis with total or partial anomalous correspondence which are completely relieved by meticulous care in correcting the refractive error.

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AMYLOID DISEASE OF THE CONJUNCTIVA*

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Amyloid is a term used to designate a product that appears as a formed element in certain intercellular regions during the course of seemingly diverse pathologic states. It is characterized morphologically by its deposition in elective sites, its more or less dependable affinities for several unrelated stains, and its homogeneity. Recent work indicates that amyloidosis is not a degenerative disease, but the result of a long-continued metabolic disorder, probably protein in nature.

The disease is referred to briefly by Fuchs,[1] Collins and Mayou,[2] de Schweinitz,[3] Berens,[4] Wolff,[5] and more in detail by Duke-Elder,[6] who states that:

> The disease attacks as a general rule young adults, especially between 25 and 30 years of age, affecting either one or both eyes; about two-thirds of the cases are bilateral. The degeneration is local and its cause is quite unknown, for the sufferers are almost invariably healthy and are not subjects of general amyloid disease; but it has a parallel in localized degenerations elsewhere—in the larynx (Courvoisier, 1902), the lung (Hersheimer, 1903), and the heart (Steinhaus, 1902). In the conjunctiva it usually begins in the transition fold, extending therefrom to the conjunctiva of the lid and the bulb. The mucous membrane appears yellow, transparent, waxy, and avascular, and in places may show swellings of considerable size. As the tarsus becomes involved the upper lids form two huge tumors of such size that the patient can hardly open his eyes; the entire conjunctiva and semilunar fold form irregular masses so brittle that they are readily torn (with, however, very little bleeding) when the lids are forcibly opened; and the cornea may be involved in the degenerative process, either the whole of it (Schreiber, 1913) or in a band-shaped area (Watanabe, 1922); alternatively, and more usually, it is disorganized by pannus.
>
> The disease goes on slowly and inexorably and medical treatment is peculiarly ineffective. The only method of alleviation is surgical removal of the larger masses when their size and weight prevent the patient from lifting the lid sufficiently. If extensive removals are required the friable conjunctiva cannot make good the defect, and it is well to use a graft of mucous membrane of the lip. Complete removal of the mass is usually impossible and inadvisable; fortunately the remainder left behind has a habit of shrinking spontaneously, although gross recurrences have been recorded (Kubik, 1924).

An early case of amyloid disease of the conjunctiva came under my observation about three years ago, and I have had the opportunity to watch the condition periodically since then.

CASE REPORT

Mrs. H. A., aged 38 years, a beauty-parlor operator for the past 15 years, came for examination on February 17, 1941, giving the following history: For the past two years the right eye has been inflamed at intervals. The eyeball becomes red, feels sore, especially at the inner corner, waters, and discharges sticky secretion in the morning. The left eye gives no trouble except that it waters occasionally. She has never worn glasses. She has dyed her eyelashes and eyebrows over a period of at least 10 years, but has used no cream around the eyelids. She does much hair tinting and handles chemicals, but has never had any skin irritation. When the inflammation in the right eye first began, she had her family physician look at the eye and he removed some lashes from the lower eyelid. She has had no treatment except boric-acid solution, occasionally argyrol, and yellow oxide ointment, which she used when the eye was particularly inflamed. For the past three or four months she has felt a thick hardness in the lower right eyelid and friends have remarked that her lower eyelids look full.

*Read at the eightieth annual meeting of the American Ophthalmological Society at Hot Springs, Virginia, May, 1944.

Examination. O.D.: The lower eyelid looked slightly fuller than the left, but there was no congestion of the overlying skin. On palpation, a hard induration, especially in the region of the fornix, could be felt. The caruncle was slightly congested, and a small droplet of mucopus was present at the inner canthus. No other discharge was evident. Along the margin of the lower eyelid on the conjunctival side was a slightly elevated ridge of pale, finely corrugated, waxy tissue like avascular granulation tissue. On eversion of the lower lid the conjunctival surface showed pale elevated vertically ridged tissue, much more pronounced in the nasal half of the lid, where it was elevated about 2 mm. above the tarsus. There was a tubular mass of this pale waxy tissue occupying the whole lower fornix, thicker near the inner canthus. On eversion of the upper lid a similar pale but smoother and less elevated avascular area was seen on the conjunctival surface, extending from the inner canthus about 4 mm. temporally. The remainder of the palpebral conjunctiva appeared normal. The eyeball appeared normal, as did the semilunar fold.

O.S.: The conjunctiva of the lower lid appeared slightly pale and waxy, but the conjunctival vessels were visible and there was very little thickening of the tissue. There was no palpable induration of the lid. No discharge was present. The upper lid was normal. V.: O.D. = 20/25; O.S. = 20/25. The patient was refracted and the following glasses given: O.D., +0.50D. cyl. ax. 170° = 20/20; O.S. −0.75D. sph. ⊂⊃ +1.50D. cyl. ax. 170° = 20/20. The pupils reacted normally to light and convergence; the intraocular pressure was normal; the media were clear; the fundi were negative.

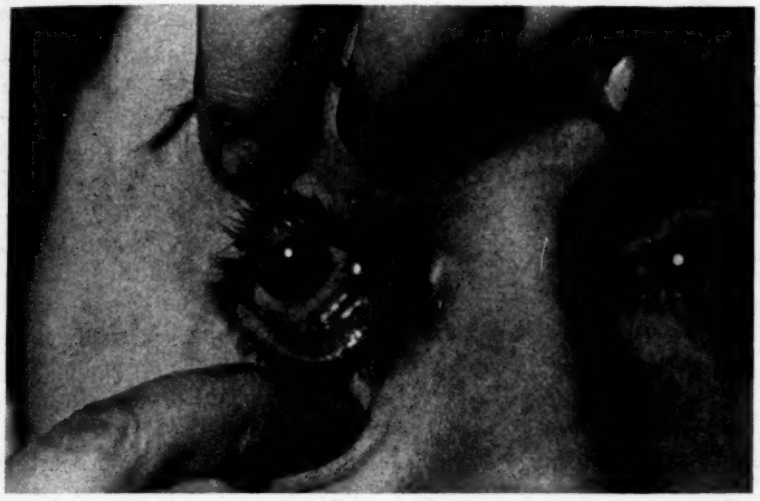

Fig. 1 (Elles). Amyloidosis of palpebral conjunctiva.*

A smear and culture from the conjunctiva were examined and reported negative for organisms. The patient was sent for physical examination to an internist, who reported the examination negative. It was decided not to give the patient the Congo red test for fear of staining her conjunctiva, as it is known that Congo red is retained in amyloid tissue for a long period of time. A biopsy specimen was taken

*Permission was given by the patient to publish her photograph.

from the conjunctival surface of the right lower eyelid near the inner canthus and the fold in the lower fornix. The tissue bled only slightly. The specimen was sent to the Army Medical Museum for examination. An examination of the tongue, pharynx, and larynx was negative except for an elevated mass at the extreme end of the right lower jaw, some distance behind the last tooth. This had the shape of a molar tooth but was soft tissue. A piece of this tissue was also sent to the Army Medical Museum for biopsy.

The report of biopsy from Lt. Col. J. E. Ash of the Army Medical Museum was as follows: "The report from your case shows the stroma of the conjunctiva infiltrated with irregular masses of homogeneous hyaline material which with special stain seems to be amyloid. The overlying epithelium shows irregular atrophy. There is a small amount of chronic inflammatory reaction about the hyaline masses. *Diagnosis:* Amyloidosis, palpebral conjunctiva.

"Report on tissue taken from lower right jaw: Two white nodules, measuring respectively 5 by 4 by 1.5 mm. and 5.5 by 4.5 by 2 mm., the external surfaces of which are fairly smooth. The smaller mass is indurated, the larger mass apparently much less dense.

"*Microscopic:* The specimen consists largely of dense hyaline fibrous tissue and except for the unusual thickness of the covering epithelium, has the appearance of an irritation fibroma. There is no evidence of amyloidosis."

The patient was given powdered liver, 4 gm. in orange juice, three times a day. This was continued until information regarding preparation of whole fresh liver was received from Dr. H. G. Grayzel of Sea View Hospital. The patient continued taking this latter preparation for nine months. She then refused to take it any longer. Following this therapy, the right eyelid became much softer, but the left lower fornix began to show a small fold of waxy tissue.

During this period, only a 2-percent solution of boric acid or a mild zinc sulfate and boric-acid solution were used locally in the eye. Occasionally a slight mucoid discharge was present.

On February 15, 1942, the patient was sent to the Eye Institute of Columbia University for consultation with Dr. Phillips Thygeson, especially for investigation as to the possibility of a virus infection as a causative factor.

Dr. Thygeson's report is as follows: "We were unable to find any local infection of bacterial, virus, or other nature which could account for the condition. We were unable to find any evidence of amyloid disease in any other part of the body. . . . The only abnormal finding was the occurrence in some epithelial cells over the lesion of eosinophilic bodies of uncertain nature, some resembling the inclusion bodies of virus diseases. We made chorio-allantoic membrane inoculations, but did not obtain any lesions. The inclusion bodies resemble those of certain virus diseases, but there is no way of proving their virus nature without obtaining positive animal or egg inoculation."

Further epithelial scrapings of the conjunctiva have been made at four different intervals and in none were the cytoplasmic inclusion bodies again found.

During the patient's stay at the Eye Institute, she was given a number of injections of liver extract.

Upon her return home she was given injections of 500 mg. of ascorbic acid every 48 hours for 6 doses. This was followed by 200 mg. of ascorbic acid by mouth twice a day. Some three months later as amyloid development in the left lower lid seemed to be increasing, she was given fresh liver in addition, which she

continued for three months when she again developed a marked distaste for it. At that time the therapy was changed to calcium gluconate, one drachm three times a day and 0.5 gr. of iodine, which she continued to take for four months. This did not affect the amyloid condition; so she was again given ascorbic acid, 100 mg., and vitamin A, 25,000 units, each twice daily. The amyloid process is showing some regression as there is no longer the small ridge of waxy tissue extending beyond the lid margin; the induration of the lids is much softer. Both upper lids remain normal save for the small originally involved area on the right upper lid near the inner canthus.

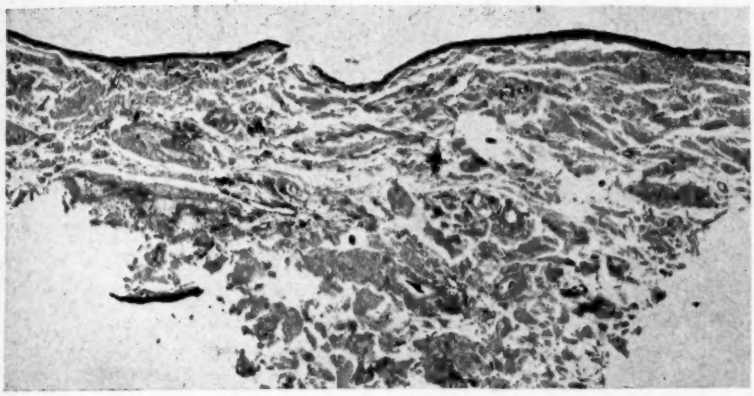

Fig. 2 (Elles). Section of conjunctiva showing diffuse deposit of amyloid throughout section; few capillaries with ring formation of amyloid; lymphocytic infiltration; crypts lined with epithelium; some epithelial masses below due to cutting of section (× 50).*

Discussion

Amyloid degeneration may follow trachoma and other chronic infections of the conjunctiva, but authors agree that these conditions are not its cause; it may arise in eyes otherwise healthy, and so be a primary affection. Primary systemic amyloidosis is a disease of unknown cause which involves tissues of mesenchymal origin, in contradistinction to secondary amyloidosis, which involves tissue of parenchymatous origin.

Reimann, Koucky, and Eklund[7] state that:

1. The primary form of amyloidosis is characterized by (a) absence of preceding disease; (b) no involvement of organs or tissue usually affected in the secondary form; (c) involvement of mesodermal tissue, cardiovascular system, gastrointestinal tract, smooth and striated muscle, and lymph nodes; (d) variation in staining reactions; and (e) tendency to nodular deposits.

2. The secondary form usually follows chronic diseases and is characterized by large deposits—especially in the spleen, liver, kidney, and adrenals—and by typical staining reactions.

3. Tumor-forming amyloidosis has been especially studied by von Bonsdorff. This form is characterized by presence of small, solitary, or multiple tumors in the eye, bladder, urethra, pharynx, tongue, and especially in the respiratory tract. It is usually of the primary type but is dis-

*Photomicrograph made at the Army Medical Museum.

tinctive enough to be grouped separately.

4. Amyloidosis occurring with multiple myeloma is in a class apart. It is secondary in nature but the distribution and character of the deposits frequently resemble those of the primary form except that huge deposits may occur in the joints and elsewhere. The spleen and liver are seldom infiltrated. Small deposits are occasionally found in the blood vessels. Thirty-seven cases have been surveyed by Magnus-Levy. According to Reimann and Eklund,[8] among the more important theories are those which claim that amyloidosis is due to: (a) a general disturbance of protein metabolism; (b) an antigen-antibody union and precipitation; (c) an absorption of protein; (d) a disturbance or abnormality of the reticulo-endothelial system; (e) hyperglobulinemia; and (f) hyperproteinemia and disturbance of the reticulo-endothelial system.

They injected rabbits with sodium caseinate three times a week over long periods and induced fatal amyloidosis. Soon after the beginning of the experiment, hyperglobulinemia developed in each rabbit, persisting until death. The total content of the blood was increased in the early period of the experiment but diminished below normal late in the course, when evidence of renal amyloidosis and uremia appeared. Their experiments support the view that chronic hyperglobulinemia is an important factor in the etiology of amyloidosis of the secondary type.

Smetana,[9] experimenting with induction of amyloidosis in mice by injection of nutrose and blocking the reticulo-endothelial system by injections of India ink to prove that the reticulo-endothelial cells are actively concerned in the formation of amyloid, draws the following conclusions:

1. The appearance of amyloid in places where reticulo-endothelial cells are normally present, sometimes in very large numbers.

2. The formation of early amyloid in the small solitary patches which suggest its local formation.

3. The occurrence of solitary patches of amyloid apparently located within the capillaries of the liver.

4. The manifold relations between reticulo-endothelial cells marked out by phagocytized ink granules, loose ink particles, and amyloid described in the text.

5. The impossibility of demonstrating reticulo-endothelial cells in areas of forming amyloid by intravenous injections of India ink.

6. The delayed appearance of amyloid in animals after blockage of the reticulo-endothelial cells by repeated intravenous injections of India ink.

Histopathology

Sections of conjunctiva of the author's case revealed an irregular surface with coarse lobulations. With hematoxylin and eosin stain the main tissue was an almost acellular pink-staining homogeneous substance. The surface was covered by stratified epithelium, usually polyhedral in shape, with small round oval blue nuclei in which chromatin was very fine. Occasional epithelial cells were vacuolated with the nucleus crowded to one side, giving a signet-ring appearance suggesting the presence of mucous secretion in the cells. The surface layer of epithelium varied from 1 to about 10 cells in thickness. A few crypts were seen on cross section, presenting a glandular appearance. Surrounding a few of these were a moderate number of lymphocytes. A small amount of exudate was present on the surface in one place, chiefly fibrin, polymorphonuclear neutrophils along with occasional plasma cells, eosinophils, and desquamated cells.

Beneath the surface there were very few nuclei, and the material was largely structureless. A few connective-tissue cells with slender nuclei and long processes were present. What appeared to be capillaries were sparse and small, although one or two had a large lumen. No blood was present in these. The lining endothelium appeared swollen. A few capillaries were surrounded by a layer of pink material giving a ringlike appearance. The greater number were free from this ringlike deposit. The homogeneous material appeared in coarse irregular lobules separated usually by thick strands of elongated cells of connective tissue and was moderately dense. Selective staining by crystal violet, Congo red, and iodine gave the staining reaction of amyloid. Crystal violet stained the material dark reddish purple, whereas the surface epithelium and connective tissue were a very distinct blue. Congo red gave the homogeneous material a strong orange-red color, whereas iodine stained it mahogany brown. The latter stain faded rapidly. Tissue submitted to the Army Medical Museum was reported by Lt. Col. Ash to give a positive iodine stain.

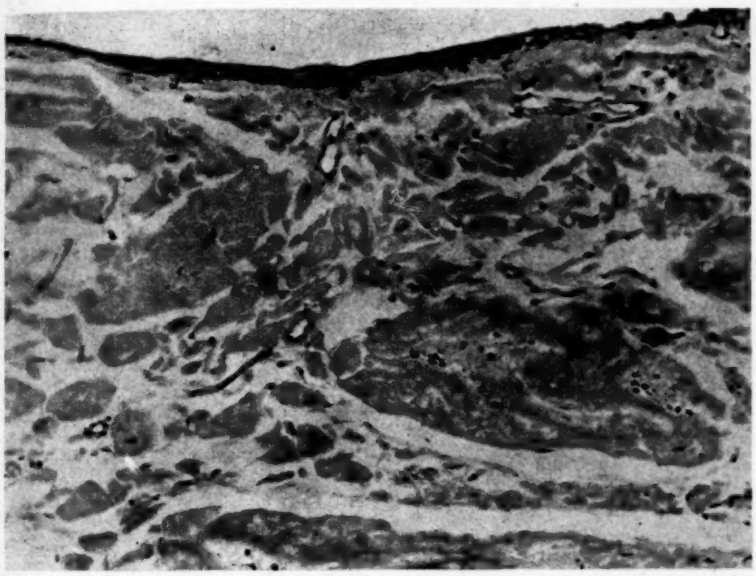

Fig. 3 (Elles). Section of conjunctiva. Note altered surface epithelium; abundant structureless material (amyloid); few connective-tissue cells; capillaries with swollen endothelium (× 260).*

* Photomicrograph was made at the Army Medical Museum.

Duke-Elder[6] states that

> Pathologically, the changes originate in the subconjunctival cellular tissue which suffers a massive cellular infiltration of plasma cells, leucocytes, mast cells, and wandering cells—of these the plasma cells are greatly predominant (Kubik, 1924). The earliest signs of degenerative material—amyloid or hyaline—are in the neighborhood of the small vessels (Wallgreen and Vannas, 1926). The commencement of the changes is in the connective-tissue fibers of the middle coat of the smaller arteries, which, with their subsequent enormous swelling so that the lumen may be obliterated, and the spread to the formed tissue elements with the destruction of the parenchymatous cells, have already been described. . . . The epithelium is thinned and may undergo cornification. Finally other degenerative changes may supervene: fatty in-

filtration (Vollaro, 1913), glycogenous infiltration (Schieck, 1908), or calcification (Vossius, 1889); Marchi, 1908; Rumschewitsch, 1909; Kolominsky, 1912).

Leo[10] in a case of amyloid disease following trachoma, gave the following description of biopsy findings over a period of four years.

In 1935, the tissue showed homogeneous masses traversed by bundles of connective tissue, chronic inflammatory processes consisting of lymphocytic infiltration and plasma cells, with prevalence of the former grouped especially around the small blood vessels and many blood vessels with thickened walls. The vessels showed endothelium but were constricted. Only certain portions took specific amyloid stain, whereas the hyaline substance took the stain more generally.

In 1936, the tissue removed showed intense amyloid degeneration. It consisted entirely of a mass of amorphous material which stains irregularly. It still showed few areas of homogeneous structure which could be stained as hyaline substance. Thin remains of conjunctiva and some small blood vessels could be seen. There was no inflammatory process in evidence.

In 1938, epithelium of the tarsal conjunctiva consisted of flat lamellar cells. The subepithelium showed a wide stratum of cells, having no particular arrangement; in some places there was a reticular arrangement of connective tissue of hyaline character but no formation of follicles as in the common form of trachoma. There were many blood vessels with thickened walls and restricted lumina. The fibrosis increased and lymphocytes were scarcer; there was a progressive increase in connective-tissue bundles with hyaline characteristics. These bundles were followed by masses of amyloid substance around the blood vessels and formed compact masses. In the middle of these masses were found small calcified areas.

As the process advanced, the inflammatory process showed more and more degenerative character. Following this was a phase of hyaline sclerosis, and later a phase of amyloid degeneration. In the second biopsy the inflammatory process had ceded to an amyloid degenerative process. In the third biopsy both processes were still going on and there was still the infiltration of trachoma.

Leo agreed with the observation of Kubik (1882) and Del Monte (1910) that there are four phases of degenerative change in evolution of the process:

1. Inflammation—cellular infiltration (plasma cells which can be absent).
2. Hyaline degeneration.
3. Amyloid degeneration.
4. Calcification.

He quoted Von Gierke as saying that amyloid prefers cartilagenous tissue or tissues rich in elastic fibers and so the palpebrae show this degeneration.

Adrogué[11] said the mechanism of the amyloid degeneration excluded any direct intervention by the plasma cells, claiming that this direct intervention was due to the absorption of the amino acids by the collagens of the interstitial network as a consequence of the bad condition of the nutritional balance which impeded elimination through the natural channels. The transformation of the plasma cells into hyaline substance is a fact that has been proved by Unna and also by Ishihara (in the conjunctiva).

Rybnikova,[12] in argument for the support of the theory that amyloid localizes along the reticulo-endothelial system, drew attention to the fact that the process begins in the tunica adventitia of the blood vessels where the largest accumulation of reticulo-endothelial cells are. A study of her case of amyloid disease of the conjunctiva gave reason to suspect that toxins first produce irritation, then depression, beginning with the tunica adventitia. In some instances the walls of the vessels showed definite marks of irritation which could be demonstrated by a very active proliferation of the cellular elements of the tunica adventitia; in others only the remnants of previously existing proliferation could be seen.

Furthermore, it may be possible that the existence of chronic toxemia (be it trachoma or other irritant) produced partial blockade of the reticulo-endothelium; its functions were decreased and finally ceased. Since reticulo-endothelium is the principal regulator of protein

metabolism, conditions may arise causing a change in local chemical process of tissue so that normal proteins brought by the blood may assume a new chemical structure in the form of amyloid.

Biochemistry

Hirschfeld, in 1882, was apparently the first to produce amyloidosis in the experimental animal. This was repeated and confirmed by Jaffe. Rokitansky, as far back as 1885, formulated the concept that the presence of amyloid substance is due to infiltration or deposit of an abnormal substance from the blood stream into the reticulo-endothelial system. Pearlman[14] says the nature of amyloid substance has remained a matter of considerable controversy. The most widely accepted view is that expounded by Krakow, who, in 1897, described amyloid as a combination of protein with chrondroitin-sulfuric acid. Perla and Gross[14] reported that this was contradicted by Hanssen, who found no chrondroitin-sulfuric acid. Eppinger found purines, diamino-acids, much tyrosine, and no carbohydrates.

Grayzel[15] and his co-workers believe that amyloidosis is probably the result of an endogenous protein metabolic disturbance. When the rate of formation of these catabolic products exceeds the ability of the tissues to dispose of them, amyloid appears. Amyloid deposition has been produced experimentally in several animal species by repeated injection of bacteria, sterile bacterial toxins, and nontoxic proteins. Among the bacteria, staphylococci seem to be the organisms of choice for the experimental production of amyloidosis. Among the toxins, diphtheria toxin is very effective, as has been repeatedly shown by the frequent occurrence of amyloid disease in horses used for the production of antitoxin. Relatively nontoxic material such as sodium caseinate, horse serum, and human serum will produce amyloid disease in mice if the materials are repeatedly injected over a period of several weeks. Amyloid frequently appears in the organs of mice which have spontaneous or experimentally induced tumors. Some investigators have claimed that amyloid disease will develop in mice maintained on a diet of nutrose or sodium caseinate. Turpentine with production of sterile abscess may call forth amyloid reaction. It would seem likely that under certain conditions a fundamental disturbance in protein metabolism may occur which results in this abnormal deposition of an unusual protein. It would be interesting to investigate whether the diet plays any role in such a disturbance in human beings.

Letterer[16] suggests in primary amyloidosis the involvement of an antigen-antibody reaction, but in the reverse sense as compared with the reaction presumed to exist in the secondary form of amyloidosis. Fowler[17] believes that amyloid is apparently a transformation product of tissue protein which is deposited in soluble form. It is always extracellular and is transported to the organ or tissue rather than synthesized *in situ*. Composition of the material has not been accurately determined, though it is known that starch and cellulose, from which the term amyloid is derived, are not present. Reimann and Eklund[8] found that hyperproteinemia precedes amyloid deposit in animals, and they consider this the abnormal substance in the blood stream. The lack of unlimited power of the organism to dispose of nonutilizable split protein products is compensated for to a certain extent by the phagocytic power of the reticulo-endothelial system. Eventually a point is reached, however, where this system can no longer undergo hypertrophy and hyperplasia, and decompensation of phagocytosis occurs. Increasing masses of material accumulate intra-

cellularly and finally the cells burst to form extracellular deposits. While hyperproteinemia and the reticulo-endothelial system undoubtedly play a role in the production of amyloidosis, it is not clear whether the hyperproteinemia is a primary factor or merely mirrors a more fundamental process.

Hass and Schulz[18] undertook to test the hypothesis of Letterer that amyloidosis is due to an antigen-antibody reaction by attempting to isolate the antibody protein from the amyloid matrix. Unfortunately, there is no satisfactory method for dissociating specific precipitates composed of protein antibody. For this reason, it is improbable that the two proteins they obtained in their experiments represent unimpaired dissociated antigen-antibody. They isolated three types of amyloid which in spite of their differences in composition disappeared from the tissues in phosphate buffer solutions at pH 11 and remained in the tissues in phosphate buffer solutions at pH 10. As amyloid disappeared from the tissues two proteins appeared in the solvent. One protein (A) comprised about 90 percent of the total protein. The second protein (B), which was always present in small amounts, had different properties. Inasmuch as fraction B was incapable of combining with fraction A to form an insoluable precipitate at neutrality, and inasmuch as they believed that amyloid is a precipitate which forms a physiologic neutrality in the tissues, an unknown component which acts on fraction A *in vivo* in a way comparable with that of acetic acid *in vitro* is a desirable part of the model.

Rybnikova[12] tells of an interesting theory by Wichmann, which represents the process of amyloid formation in the following manner: Owing to the toxic disturbance of the cellular metabolism the function of the cells is impaired to such an extent that they are unable to assimilate the albumin brought by the blood. This surplus of albumin is deposited in the interstices, and there under the influence of some ferment secreted by the cells or some other unknown cause is transformed into amyloid.

Grayzel[15] and his co-workers, in experimenting on mice, found that inadequate or deficient diets do not accelerate the development of amyloidosis. Mice fed a synthetic and the so-called stock diet to which vitamins A and B were added showed definite evidence of retardation of the production and formation of amyloidosis.

Differential diagnosis

Amyloid disease may involve not only palpebral conjunctiva, but also the bulbar conjunctiva and the cornea. The process may be diffuse, or may assume the aspect of a well-delineated tumor. It is to be differentiated from hyalinization of the eyelid, tarsitis syphilitica, fatty degeneration, as well as various neoplasms, benign or malignant, diffuse lymphoma, plasmoma, scleroma, lymph- and hemangioma, and forms of sarcoma. Only histopathologic examination of the tissue determines the real nature of the disease.

Intravenous injection of Congo red is the specific test for the presence of amyloid. This simple clinical method for the diagnosis of amyloidosis was first described by Bennhold, in 1923. Among normal persons, 19 percent of the dye disappeared from the blood stream in one hour after injection, whereas among patients with amyloidosis 40 to 100 percent of the dye was found to have disappeared. This observation has been confirmed by many observers. Waldenström[19] was able to take specimens from the liver for biopsy with a specially made trocar, and by this method he was able to follow the development, reabsorption, and complete disappearance of the dye in the liver.

Friedman and Auerbach[20] have recently published an improved method of Congo-red injection for diagnostic testing. One might hesitate to use it in a case of conjunctival involvement, because of the prolonged retention of the dye in amyloid tissue, unless surgical removal of the involved tissues is contemplated.

Hyaline degeneration has been considered by several observers—Kubik,[21] Ernyei,[22] Leo[10]—as an early stage of amyloidosis.

Kreibig[23] stated that there was no connection between amyloidosis and plasmocytoma as these diseases are due to entirely different reactions of the organ. There are no well-defined cases in which both of these conditions appeared simultaneously. Trachoma was almost always present in plasmocytoma, and relatively few cases of trachoma developed amyloidosis.

Treatment

Excision of the tissue involved in amyloid disease of the conjunctiva, either entirely or in part, is the method of treatment universally advised in the reports published in various countries. At times where the denuded area is extensive, grafts of mucous membrane from the mouth have been successfully applied. Many authors report that total ablation is not necessary, as they have found the remaining amyloid tissue undergoes retrogression.

The reports in general medical literature of amyloid disease being cured (especially in tubercular patients by prolonged administration of liver, powdered or fresh), a case of cure with only symptomatic treatment reported by Halbein,[24] and Waldenström's[19] report of his ability to show that complete disappearance of amyloid is possible in man despite extensive infiltration of the liver, influenced me to treat my patient on the theory that amyloid formation in the conjunctiva is a deficiency rather than a degenerative disease.

According to Dalldorf,[25] ascorbic acid is an essential nutrient required for the normal deposition and maintenance of intercellular substances. This includes the collagen of all fibrous tissues and of all nonepithelial cement substances (the intracellular material of the capillary wall, cartilage, dentin, and bone matrices).

During vitamin-A deficiency the Kupffer cells become swollen and degenerate. It is quite possible that a part of the effect of vitamin-A deficiency on infectious diseases is due to this involvement of the reticulo-endothelial system (Eddy and Dalldorf[26]).

The patient cited in this paper has been given fresh liver over a period of many months, followed by vitamin C and later by vitamins C and A, with a resultant slow regression of the disease.

Conclusions

Amyloidosis may manifest itself in the conjunctiva as a primary and, perhaps, as a secondary disease. The fact that most cases reported have followed or complicated trachoma need not necessarily mean that the trachoma is a factor in the development of amyloid, for the majority of trachoma cases do not develop amyloidosis. The geographic location of most cases of eye involvement—that is, the Baltic states, Russia, Japan, and China, where deficiency diseases are more prevalent—would indicate that this might be a factor.

There is no single pathologic criterion upon which a diagnosis of primary amyloidosis can be made. The absence of preceding suppurative disease; the lack of evidence of amyloidosis in the internal organs commonly involved; the presence of amyloid in smooth or striated muscles, especially in the cardiovascular system,

gastrointestinal and genito-urinary tracts, tongue, more rarely in the alveoli of the lungs, and the sebaceous and sweat glands —all sites of primary amyloidosis; the atypical staining reactions to Congo red and iodine sulfuric acid; and the nodule formation that is found in conjunctival cases are at present the only bases for diagnosing the primary form.

Biochemically, the process of amyloid deposit appears to be a disturbance in protein metabolism, due not to transudation of a protein substance formed in the blood stream, but to an endogenous protein metabolic disturbance, in which the rate of formation of catabolic products exceeds the ability of the tissues to dispose of them.

Histopathologically, most evidence points to primary involvement of the phagocytic reticulo-endothelial cells, whose location is exactly in the places where amyloid is constantly seen. The changes begin in the connective tissue of the tunica adventitia of the smaller arteries.

The Congo-red test is diagnostic, but should not be given in cases of eye involvement because of the retention of the stain in the tissues, unless surgery is to be done immediately. Iodine, Congo red, and crystal violet stains give characteristic coloring to amyloid material.

The only treatment of eye cases reported is surgical removal of the amyloid diseased tissue.

Definite, but slow, regression of the amyloid process in the author's case treated first by ingestion of fresh liver, later by vitamins A and C, would suggest the disease is due to a deficiency.

It might be desirable to abandon the term degeneration entirely in regard to amyloid formation in the tissues and to refer to the condition as amyloid disease.

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CLINICAL EFFECTS OF THE LOCAL USE OF SULFONAMIDES ON THE EYES

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The local use of sulfonamides for the treatment of pathologic ocular conditions is based on the fact that these drugs are relatively innocuous when they come in contact with the ocular tissues, as was demonstrated in *anima vili* (rabbits) in 1938 by Rambo[35] and clinically proved later by many other authors;[16] it was also proved that sulfanilamide readily penetrates into the ocular globe with topical use, as do sulfapyridine and sulfathiazole; also sulfadiazine when iontophoresis is used or when an agent capable of breaking superficial tension is employed beforehand. Any of the four sulfonamides mentioned above are efficacious in the treatment of pathologic conditions of the conjunctiva and cornea, whether they are used in powder or ointment form. Local use of azosulfonamides, however, is not plainly justified, for this drug is transformed into sulfanilamide only within the human organism, and the favorable clinical results that have been reported should merely be compared with those obtained by the use of ordinary nonirritating collyria (Bellows[5]). Another considerable advantage of the therapeutic use of sulfonamides by local application is that the quantity of the drug entering the organism is practically negligible, the desired concentration being obtained only in the affected region, this being much greater than any concentration obtainable by any other means of administration; moreover, the time spent in obtaining the desired concentration is very much reduced.

According to Thygeson[43] it seems probable that the topical use of sulfonamides in ocular therapeutics will largely supplant the oral administration, because in the future it will be possible to use drugs with a highly active local effect, the toxicity of such drugs making their

use unadvisable *per os* or parenterally.

The local use of the sulfonamides in ocular therapeutics, however, was not accepted at once. Some years after the oral and even parenteral use of these drugs had been accepted in the treatment of ocular diseases, references to their local use were rare. This may be explained by the fact that the sulfonamides are only slightly soluble in water, which is the base ordinarily used for collyria. Sulfanilamide reaches its maximum concentration at less than 1 percent (0.8 percent) and at this concentration the collyria were not really very efficacious when instilled, ocular baths giving better results (Mengel[24]). It was necessary to resort to insufflation of the drug in powdered form (P'an[29]), but since this was not well tolerated, administration in this form was really impractical. Subconjunctival administration was then tried (Paton[31]); later came the ointments, the preparation of which at first did not give satisfactory results. These were followed by sodium salts of the various sulfas, their solubility in water being much greater; but a high pH was needed, making the collyria in question irritating. This step was followed by local administration with iontophoresis, which allows a rapid penetration of large quantities of sulfa into the ocular tissues. Although the prior use of agents capable of breaking the superficial tension of the cornea is still in its experimental stage, it promises to open up new means of the local application of the sulfas in the treatment of ocular diseases.

Action of the sulfonamides applied directly to the ocular tissues

The action of sulfonamides is known to be bacteriostatic and not truly bactericidal. On accepting the hypothesis that the sulfas act by affecting the para-aminobenzoic acid, one must take into consideration, in their local therapeutic use, that the anesthetizing collyria have structural formulas similar to the structure of that acid and that therefore their simultaneous use with the sulfas will hinder their respective action. In the same way and according to the same theory the existence of abundant secretion might also hinder the local action of the sulfas.

One might think that the sulfonamides would have an inhibiting effect on the phagocytic action of the white blood corpuscles. Experiments carried out on animals, outside the field of ophthalmology, demonstrate the opposite: among rats inoculated with agents of gas gangrene, phagocytosis was greater in those that had been given sulfonamides locally in the wounds.[36]

However, experiments carried out by Bellows[4] show that corneal reëpithelization in rabbits took, on an average, 5.1 days, whereas in rabbits treated locally with sulfonamides the period of epithelization was 13.6 days.

Berens, Gara, and Loutfallah's[6] observations agree with those of Bellows, the former authors having found that the period of cicatrization of corneal wounds in rabbits treated with ointments with or without sulfonamides was longer than in those which received no treatment. These authors also found that when the wounds were infected with Staphylococcus aureus, the percentage of cures was greater in the eyes treated with 5-percent sulfa ointment.

Bellows[4] states that local application of sulfonamides to the cornea not only retards cicatrization but causes the formation of vascularized scars.

The clinical inference from these facts is that the sulfonamides should be applied locally to corneal wounds only when there is suspicion of infection. Conversely, according to personal observations in clinical practice, the aforementioned experiments can be confirmed, for in infected

ulcers of the cornea the use of sulfonamides should be suspended when the ulcer by its aspect shows that it is regressing, so that by continuation of treatment the drug will not retard cicatrization.

Methods used in local sulfonamidotherapy

The sulfonamides used topically in ophthalmologic therapeutics are sulfanilamide, sulfathiazole, and sulfadiazine, sulfapyridine being used much less frequently. Sulfanilamide is soluble in water up to 0.8 percent and this aqueous solution has been used. Sulfathiazole and sulfadiazine are less soluble in water and for aqueous collyria their sodium salts are employed. Sodium sulfacetamide, from which solutions up to 30 percent can be obtained, has been widely used for topical applications in ophthalmology (Pillat[32]). Tolerance of these collyria is good; generally there are no irritative phenomena. It is advisable that they should be isotonic. The collyria may be instilled frequently at short intervals (every 5 seconds, 60 times) or used as an ocular bath for 3 to 5 minutes, repeated every 2 hours. Liquid collyria of sulfonamides may also be used for irrigations of the conjunctival cul-de-sac, these irrigations being repeated more or less frequently according to the case, at intervals of from 15 minutes upward between irrigations (Rein and Tibbetts[37]). Pure sulfonamides can be used by insufflation, dusting or insufflators being used for this means of administration.[13] Insufflations are generally given every three hours. This method of application is useful for patients in hospital, but is difficult for use with out-patients.

It is necessary to keep in mind that due to the mode of action of the sulfonamides in inhibiting the development of the germs, without, however, destroying them directly, a continuous local action is indispensable, so that instillations should be repeated frequently, and insufflations should be given so that there will always be a reserve quantity of sulfonamides to be dissolved by the tears.

Sulfonamides when administered by insufflation, however, do not seem to be completely innocuous, and irritative phenomena resulting from this method of using the drug have been reported (Guyton and Woods[15]). Bellows[4] also verified the appearance of chemosis and coloration of the corneal epithelium after application of powdered sulfonamide for two hours. Sulfanilamide and sulfadiazine seem to be better tolerated in local application than is sulfathiazole. In any case it is always preferable to porphyrize the drug or to use the microcrystals. (Thygeson,[43] Leopold and Scheie[2]).

Ointments present several advantages over the collyria in the local application of the sulfonamides to the lids, conjunctival cul-de-sac, and cornea, because as the sulfonamides are but slightly soluble in water, aqueous collyria of their sodium derivatives, which are sometimes irritating due to their alkalinity, are generally used, whereas in the ointments pure sulfonamides can be employed. Besides this the ointments are generally well tolerated by the patients, whose only complaint is the disturbance of visual acuity caused by the extremely thin layer of unctuous substance that forms on the cornea. Emulsions, according to Thygeson and Braley,[44] are advantageous in that the drug is released more rapidly, but their drying properties make them irritating when used on the lids. Ointments also allow for a more prolonged action of the drug. Thygeson and Braley found that the base which kept its drug-diffusing property the longest was hydrous wool fat; evident traces of the drug were present in the cornea of rabbits 60 minutes after only one application of 5-percent sulfa-

thiazole ointment in this base. This finding demonstrates that with an adequate base, ointments can be used less frequently than the aqueous collyria and yet have a similar effect.

Ointments must have certain requisites to make their administration effective, these requisites varying according to whether the ointment is to be used on the skin or conjunctiva. Therefore, according to Pillsbury, Wammock, Livingood, and Nichols[33] ointments for use on the skin of the lids should retain the drug in a finely divided state at the site of application for the longest possible time period; (2) allow close contact of the sulfa with the site of infection; (3) be miscible with mucous and purulent secretion; (4) not form a tight waterproof layer under which bacteria could develop; (5) allow for easy removal of the bacteria found in the crusts. These authors found that purely fatty bases such as petrolatum, hydrous wool fat, and the like, all have the requisites required by item 1 but do not meet the demands for the other items; they state that they prefer an emulsion in which the sulfonamide is first dissolved or kept in suspension in water, this suspension or solution being afterward emulsified with the greasy base. These emulsions permit a more intimate contact between the drug and the affected part, they mix with secretions and, owing to the lessened superficial tension, a better release of the drug to the tissues is obtained. For the conjunctival cul-de-sac the use of a hydrous-wool-fat base seems to be preferable. Elvin[12] recommends the following formula: To 4 parts of sodium alginate add 75 parts of boiling water; emulsify and strain, and then stir until cool. Add 16 parts of anhydrous wool fat, 78 parts of white petrolatum, and 1 part of sodium chloride dissolved in 4 parts of water. This base was found to be the best for the use of sulfanilamide or sulfathiazole.

The breaking of superficial tension beforehand by the use of detergent preparations permits a far greater penetration through the cornea and aqueous when sulfonamides are applied locally. Detergent preparations are understood to contain the necessary ingredients for lowering superficial tension, thus permitting an increase in penetration. These preparations consist of molecules containing polar and nonpolar groups. As a result these molecules are concentrated on the surface of the cornea and orient themselves so that the polar group comes in contact with the epithelium and the nonpolar portion is directed to the surrounding media. Consequently interfacial tension between the surrounding media and the epithelium is reduced, causing increased penetration not only of the detergent but also of the surrounding elements. It is known that one of the reasons of the difficulty for the penetration of the sulfas into the cornea is due to their polar nature (Swan and White[42]). Therefore a previous application to the cornea of a preparation capable of reducing superficial tension would logically increase penetration of the sulfas.

In 1942, Alvaro and Silva,[1] assisted by Prof. Q. Mingoja for the chemical part (in a paper presented before the Section of Ophthalmology of the American Medical Association) demonstrated that after instillation of 1 drop of a 15-percent aqueous solution of sulfacetamide '60 times in succession at 5-second intervals into rabbit eyes, a concentration of 2.23 mg. of sulfa per 100 c.c. was obtained in the aqueous after half an hour. However, if a drop of dioctylsulfosuccinate was instilled previously and the same experiment repeated, the concentration in the aqueous rose to 8.68 mg. per 100 c.c. Bellows and Gutman,[3] also experimenting with rabbits and using various preparations to lower superficial tension, such as dioctylsulfosuccinate (known by the com-

mercial name of "Aerosol OT"), isopropyl naphthelene sodium sulfonate ("Aerosol OS"), higher secondary alcohol sulfate ("Tergital 4.7"), synthetic primary alcohol sulfate ("Tergital 0.8"), oleyl alcohol ("Ocenol KD"), high-molecular alkyl, dimethyl and benzyl ammonium chlorides ("Zephiran"), were able to increase the penetration of sulfathiazole in the aqueous in similar proportions. Zephiran was the only agent with which results were not so satisfactory. These authors verified that with 0.2-percent detergent solutions ("Aerosol OS") they were able to obtain an increase in penetration of the sulfa in the aqueous and with 10-percent solutions saturation was attained. Solutions of these detergents of less than 2 percent do not seem to harm the cornea, and this leaves a wide margin of safety if detergent solutions of 0.3 to 0.5 percent are used, for their effect on the increase of penetration is already great.

The existence of vasodilatation and inflammatory conditions of the cornea facilitates corneal penetration, as does also application of local heat for the same reasons.

Owing to the fact that sulfonamides penetrate into the aqueous in large quantities when administered subconjunctivally, their clinical use by this method was established. Paton[31] employed subconjunctival injections of neoprontosil in 0.2 to 0.3 c.c., using 2.5- and 5-percent solutions. Good results were obtained and local inflammatory reaction was not very great. This method of administering the sulfonamides locally in ocular therapeutics has not been generally favored owing to the fact that similar or even better results can be obtained by the use of iontophoresis without the inconveniences of subconjunctival injection.

Leduc, in 1900, suggested making chemical agents penetrate into the human organism by means of an electric current. Application of this method to the visual apparatus seems to have been done by Wirtz in 1908, but it was Cantonnet who, in 1927, reviewing the literature on the subject and adding his own theories, established this therapeutic method in ophthalmology.

The passage of the galvanic current to the cornea, whether by application of the negative pole or of the positive pole, causes a decrease of tension in the globe, which has been verified by Myerson and Thau.[28] This decrease is more pronounced when the negative pole is applied to the cornea, is independent of the application of chemically active agents, and takes place even when distilled water is used. Myerson and Thau explain this decrease in tension as the result of a vasodilatation or some more complex chemical action. In any case the passage of the galvanic current stimulates the parasympathetic system, as can be seen by the contraction of the pupil and narrowing of the palpebral fissure.

In iontophoresis with sulfonamides the negative pole is applied to the cornea and the positive pole to the nape of the neck. We have found in a series of patients undergoing iontophoresis for various reasons that there is invariably a decrease in ocular tension, very variable, however, for each individual and even in the same individual from day to day. This decrease was from 10 mm. Hg to 1 or 2 mm.

For iontophoresis small glass cups with a metallic electrode at the bottom may be used. The patient, with his head down, submerges the cornea in the liquid contained in the cup; or a glass tube open at the ends may be applied to the limbus, filled with an adequate solution and an electrode dipped into the liquid; or a cotton-wool pledget soaked in the solution may be placed on a metal disc connected with the negative pole of the ap-

paratus, the wet cotton wool being made to come into direct contact with the cornea. With this last method it is generally necessary to anesthetize the cornea, which, as we have seen, is inconvenient, and also there is a danger of trauma.

In order to combine the action of the drug which penetrates into the tissues by means of the galvanic current and the mechanical action of massage, we have used an adequate electrode covered with gauze and soaked in the solution indicated. With this we massage the palpebral conjunctiva in cases wherein such massage is necessary, as will be seen further on.

The current used is 1 to 2 Ma. With 1 Ma. Boyd[7] found that penetration of sulfathiazole in a 5-percent solution in the cornea and aqueous was three times greater than that obtained with an ordinary ocular bath of equal duration. With 2 Ma. increase of penetration was 9 times greater in the aqueous and 10 times greater in the cornea. The increase of the concentration of the sulfonamide solution determined an increase in concentration of the drug in the tissues, which, however, was not proportional to that increase. Boyd[7] found no corneal lesion caused by iontophoresis with sulfathiazole solution.

Von Sallmann,[48] experimenting with rabbits, found that the penetration of sulfadiazine by iontophoresis was even greater than that obtained by Boyd with sulfathiazole; penetration of sulfacetamide and sulfapyridine, however, was less. Von Sallmann also found that the penetration of the drug is very rapid, reaching a maximum concentration in 15 minutes, remaining in all the tissues and liquids of the anterior segment of the globe for four hours in a bacteriostatic condition.

For iontophoresis we have regularly been using solutions of sodium sulfacetamide or sodium salts of sulfanilamide in strengths of 5, 10, and 15 percent in various cases. The clinical results observed, which are given further on, justify our belief in the effective penetration of the drug by this method of administration. Serious irritative phenomena were not observed, these applications being well tolerated by the patients. We use a 2-Ma. current and the application is of 2 to 5 minutes' duration, according to the case.

There are other methods of applying sulfonamides locally to the visual apparatus, but their use is less generalized. Igersheimer[17] refers to a case of traumatic purulent iridocyclitis with indication for enucleation due to the pronounced irritative phenomena and slight perception of light, in which, besides the classical therapy with heteroprotein, he injected a solution of 0.8-percent sulfanilamide into the anterior chamber. Inflammation disappeared, and a final visual result of 20/40 was obtained after iridectomy and extraction of cataract had been performed. Laval,[20] encouraged by this case history of Igersheimer, presents a case of a patient operated on for cataract in which, due to vomiting, gastric liquid entered the conjunctival cul-de-sac of an eye wherein the anterior chamber was open; in order to avoid possible infection, an irrigation of the anterior chamber with a 10-percent solution of sodium sulfadiazine was performed. No irritative phenomena of any kind were observed. Puga[34] also refers to excellent results in a case of abscess of the vitreous in which he substituted 0.6 c.c. of vitreous with an injectable solution of prontosil rubrum. In another case of recurrent uveitis with cataract the inflammatory phenomena ceased after intravitreous injections of the same drug.

Lavage of the lacrimal sac with sulfonamide solutions has also been used. Leopold and Scheie refer to having used a 5-percent aqueous suspension of sulfathiazole and sulfapyridine with microcrystals,

without causing irritation and with good therapeutic results. Puga[34] also mentions having done the same with neoprontosil.

Local administration of the sulfonamides does not exclude the oral or parenteral use of the drug. Its use may be supplementary, taking advantage of the rapidity of penetration of the sulfas into the eye, when the application is local, in order to obtain an immediate bacteriostatic effect whilst waiting for the drug administered by mouth or parenterally to reach the concentration necessary to produce a therapeutic effect after a few hours. When the sulfonamides are used orally or parenterally and locally it is not necessary to consider the quantity of the drug absorbed locally, for even if a maximum penetration is obtained there is no danger of a toxic effect.

It has been found, and we have already referred to the fact, that an increase in the body temperature favors absorption of the sulfonamides and also their bacteriostatic action; there is, therefore, no reason to contraindicate the simultaneous use of therapeutic agents which cause an increase in temperature and of sulfonamides; rather, simultaneous administration of foreign proteins, vaccines, toxoids, and the like, with the sulfas should always be indicated when necessary.

According to Thygeson[43] studies by Schmelkes and Wise[40] show that azochloramide and oxidizing agents increase the bacteriostatic power of the sulfonamides, so that something can be hoped for from this source, although so far clinical experiments are lacking.

With the local use of the sulfonamides no phenomena of general poisoning need be feared, for the quantities of the drug absorbed are truly very small. There are cases, however, in which patients with a great sensitivity to the sulfas showed local allergic manifestations when collyria or ointments containing sulfonamides are applied. Howard Morrison[26] refers to a case of allergic blepharoconjunctivitis due to the use of an ointment of sodium sulfathiazole. When the use of the drug was suspended the symptoms of irritation disappeared, but reappeared in one eye only in which ointment had agaain been applied, this time of sulfathiazole. Thygeson and Braley[44] also describe several cases of conjunctival inflammation with dermatitis of the lids, pruritus, and conjunctival eosinophilia. They also observed similar cases when sulfanilamide, never when sulfadiazine, was applied locally. Personally I have observed several cases of allergic irritation caused by the local use of sulfonamide collyria and ointments, specifically with the use of sodium sulfacetamide and sulfanilamide, whether in the form of aqueous collyria or ointment to be applied in the conjunctival cul-de-sac and on the skin of the lids. All authors are unanimous in stating that with suspension of the local use of the drug, inflammatory symptoms rapidly disappear, leaving no permanent damage.

Therapeutic indications

As the sulfonamides may frequently cause toxic manifestations of a certain seriousness, their use *per os* or parenterally or intravenously should not be prescribed without due reason. Owing to the facility with which penetration of the drug is obtained locally, this method is indicated as the method of choice when the desired effects can thereby be obtained. There are cases, however, in which paradoxically results are not so encouraging with local as with oral methods.

Diseases caused by virus

Regarding ocular virus diseases, local treatment with the sulfonamides is limited to granular conjunctivitis and inclusion conjunctivitis. In the latter this is the

treatment of choice,[45] good results having been obtained especially in children. Generally, 5-percent sulfathiazole ointment in the conjunctival cul-de-sac 6 times a day is used.

Since the sulfonamides were found to be of great value in the treatment of trachoma,[10] several authors have sought to obtain good results with local application of the drug. Amaral[2] in 1939 states that he obtained good results with massage of the palpebral conjunctiva of trachomatous patients with a 2-percent sulfanilamide ointment. Cosgrove,[11] in in 1940, also mentions good results in a series of patients undergoing treatment consisting of the instillation of an 0.8-percent sulfanilamide solution 4 to 6 times a day. Results were equivalent to those obtained in another series treated with sulfa orally. Subconjunctival injections of neoprontosil[8] have also been used with good results, according to Paton[31]; Morante[25] has used insufflations and massage with powdered sulfanilamide. Victoria and Artigas have used a collyrium of sulfathiazole (see Sená[41]). The majority of authors, however, advise the use of collyria of sulfanilamide, but the number of enthusiasts for the local treatment of trachoma with the sulfonamides is relatively small, treatment by mouth being advocated as a rule.

Personally, and in the Eye Clinic of the Escola Paulista de Medicina, we usually associate the administration *per os* of the sulfonamides with local treatment with collyria containing 15-percent sodium sulfacetamide. This treatment is given for 2 to 3 weeks until regression of the inflammatory phenomena is observed, then treatment *per os* is suspended, and massage with an electrode soaked in a 5-percent solution of sulfacetamide with a galvanic current of 2 Ma. is instituted. These massages aim at destroying the follicles and at the same time guarantee a sufficient concentration of sulfonamide in the affected tissues. Ionization massage is given for 2 to 3 minutes and repeated daily. Series of 20 massages are given at intervals of 10 days, and at the end of each series the patients are reëxamined in order to see whether treatment should be continued or not. Results are generally very good, the active signs of trachomatous infection disappearing together with the follicles.

It is obvious that at least a partial substitution of the general treatment by local treatment would be of great advantage, as this would permit a much more universal use of the sulfonamides in the treatment of trachoma.

Diseases caused by bacterial infection

Gonococcic conjunctivitis, which has been effectively treated by sulfonamides administered orally, has also been treated locally by some authors. Mullen[27] used washes of a 0.2-percent solution of sulfathiazole repeated every 10 minutes. Rein and Tibbetts[37] used irrigations of a solution of sulfanilamide with very good results, and Panneton,[30] using powdered sulfanilamide, also obtained very good results. The seriousness of this ocular disease, however, seems to justify running the risk of using the sulfonamides *per os*, and perhaps it would be wiser to advocate a mixed treatment in cases of gonococcic conjunctivitis, as with this method the doses of sulfa taken orally can be reduced sooner. Sulfadiazine seems to be the sulfonamide of choice for local application in these cases (Thygeson[48]).

Pillat[32] successfully used a 10-percent collyrium of sodium sulfacetamide at 30-minute intervals in gonococcic conjunctivitis of the newborn.

I have used instillations of a collyrium of this same drug in a 15-percent isotonic solution, instilling one drop at half-hour

intervals, with very good results. Once a day the same solution is instilled 60 times at 5-second intervals, this guaranteeing a good penetration of the drug through the cornea. This treatment may or may not be associated with administration of sulfonamides *per os* and protein therapy according to the gravity of the case.

In ocular diseases caused by various types of streptococcus the sulfonamides are of great value. Conjunctivitides caused by streptococcus and corneal disturbances of the same origin can also be influenced by the sulfonamides applied locally, repeated mention being found in the literature as to the good results obtained by application of the drug.

The action of the sulfonamides is much more efficacious, specifically sulfathiazole, in ocular diseases of staphylococcic origin. It is known that the staphylococcus is the germ that is probably responsible for the greatest number of ocular disturbances of bacterial origin: hordeolum, which is nearly always of staphylococcic origin, and blepharitis, which is frequently caused by the same bacteria, are benefited by the local use of 5-percent sulfathiazole ointment, the action of the other sulfonamides being far less effective and sometimes nil. Thygeson[47] mentions good results obtained in the treatment of blepharitis with the use of 5-percent sulfathiazole ointment applied 6 times daily at regular intervals in the form of massage of the palpebral border. In recent cases the treatment is always effective, whereas in old chronic cases it is sometimes necessary to associate other therapeutic measures. In the latter cases epilation of the infected cilia and expression of the meibomian glands are sometimes essential. My own clinical experience with a large number of patients thus treated within the last two years has confirmed this observation. Also in cases of staphylococcic impetigo and infected eczema of the lids sulfathiazole ointment has given excellent results.

Corneal ulcers of staphylococcic origin usually heal better with the use of powdered sulfadiazine (Thygeson[43]) applied to the conjunctival cul-de-sac at intervals of 3 or 4 hours. It is always necessary in these cases to eliminate the coexisting blepharoconjunctivitis in order to avoid recurrences. I have used iontophoresis of solutions of 5-percent sodium sulfacetamide in many cases of corneal ulcers of staphylococcic origin and results have invariably been good. I usually give applications of 3 to 5 minutes' duration with a current of 2 Ma. In cases of conjunctivitis caused by staphylococcus I have also used, and with very good results, instillations of collyria of 15-percent sodium sulfacetamide, repeating the instillations more or less frequently (every hour or at longer intervals) according to the evolution of the case. Robson and Scott[38] also mention having obtained good results with instillations of this same drug in concentrations of 2.5 to 30 percent in the treatment of conjunctivitides of various origins.

Chronic conjunctivitides constitute a therapeutic problem that it is sometimes difficult to solve. From the bacteriologic point of view the germ most frequently found is the Staphylococcus aureus. Thygeson and Braley[44] with clinical experimentation found that the use of 5-percent sulfathiazole ointment was effective in the treatment of these cases as against the uselessness of the classical treatment. They also found that in cases wherein the Morax Axenfeld diplobacillus was present, treatment with zinc sulfate was useless until the staphylococcic factor was eliminated. Clinically we have found the treatmnet of chronic conjunctivitides by sulfonamides very effective, good results having been obtained with the application of collyria of 15-percent

sulfacetamide. In cases of chronic conjunctivitis it is very important to eliminate the foci of blepharitis, which are nearly always caused by the staphylococcus. These foci may lack subjective symptoms and objectively only a careful examination will show small scales, which are visible with a magnifying lens, on the roots of the lashes. It is therefore indispensable in cases of chronic conjunctivitis, in addition to applying ointment or collyria of sulfa to the conjunctival culde-sac, to apply this ointment also to the palpebral border.

One of the germs that most frequently causes acute catarrhal conjunctivitis is the Koch Weeks bacillus (Haemophilus influenzae). Experiments carried out *in vitro* by Guyton,[14] which have been clinically confirmed, show that the sulfonamides (sulfanilamide and sulfapyridine) have a favorable action in the treatment of this conjunctivitis. Thygeson and Braley[44] found that whereas with the staphylococcus, which is also a frequent cause of acute conjunctivitis, the action of the classical methods of treatment is manifestly inferior to that of sulfathiazole, with the Koch Weeks bacillus and with the pneumococcus the action of the classical medication and of sulfathiazole is more or less equivalent. Practically, we may deduce from this statement, the advantage of the systematic use of sulfonamides which in the worst hypothesis could only have an equivalent action to that of the best medication. My experience confirms that the use of 15-percent sulfacetamide is effective in the treatment of acute catarrhal conjunctivitides caused by the Koch Weeks bacillus, by the pneumococcus, or by staphylococcus.

The pneumococcus causes ocular disturbances such as conjunctivitis, corneal ulcerations, dacryocystitis, and the like. Favorable results in the treatment of these conditions with the local use of powdered sulfapyridine in corneal ulcers has been mentioned (Johnstone[18]). Due to the avascular nature of the cornea large concentrations of sulfonamide are necessary in order to obtain an effective bacteriostatic action against the pneumococcus, therefore iontophoresis with sulfathiazole or sulfadiazine is indicated. I have obtained very good results with iontophoresis with sodium sulfacetamide in cases of corneal ulcers due to pneumococcus. As the disease is of a serious character, however, I always associate oral administration of the drug and other therapeutic agents indicated, such as foreign-protein therapy.

Pneumococcic conjunctivitis (catarrhal, acute, or chronic) generally does not endanger the eye and responds equally well to the classical treatment and to sulfonamide treatment.

The pyocyaneus bacillus causes severe corneal ulcerations which lead to perforation and panophthalmitis within a few hours. Ocular manifestations of pyocyaneus infection although responding badly to ordinary treatment can be effectively treated with sulfadiazine iontophoresis (Von Sallmann[48]), by instillation of sulfacetamide collyria (Robson and Scott[38]), or by combined oral and local administration of sulfadiazine (Thygeson and Stone—ref. by Thygeson[43]). Sulfapyridine was used by Lepard[22] and by Joy[19] before the discovery of the other sulfas. In a serious disease such as ulcers of the cornea due to pyocyaneus[9] it is necessary to act quickly, therefore associated administration orally and by iontophoresis of the drug is recommended in order to obtain and maintain a concentration of sulfonamide which will check the growth of the germ.

Morax Axenfeld's diplobacillus causes conjunctivitis and corneal ulcerations which respond well to local sulfonamide treatment with 5-percent sulfathiazole

ointment.[44] I have used 15-percent sodium sulfacetamide with very good results in cases of conjunctivitis caused by this germ, and iontophoresis with a 5-percent sulfacetamide solution is also effective in the treatment of corneal ulcers of this same origin.

Meningococcus rarely causes conjunctivitis. Recently, however, Thygeson[46] mentioned a case of primary meningococcic conjunctivitis which responded well to treatment with sulfadiazine orally combined with applications of 5-percent sulfathiazole ointment every two hours.

The coli bacilli rarely cause pathologic disturbances in the eyes, but treatment with sulfonamides (sulfathiazole and sulfadiazine) applied locally should be the treatment of choice. Rare, too, are inflammations caused by the bacilli of the Proteus group or by the Friedländer bacillus. But either one responds well to local sulfonamide treatment.

Prophylactically, instillation of 15-percent sodium sulfacetamide has been found beneficial during the preoperative and postoperative period, the secretion found in the dressings after surgical operations being manifestly decreased, probably due to lesser irritation caused by this collyrium in comparison with other antiseptic agents.

Guyton and Woods,[15] who obtained good results with the prophylactic use of sulfadiazine orally in cataract extractions, mention having observed undesirable irritations due to the application of powdered sulfadiazine to the conjunctival cul-de-sac.

Igersheimer[17] relates the dramatic results obtained with injections of sulfanilamide into the anterior chamber in a case of purulent endophthalmitis. Bacteriologic examination of the purulent aqueous revealed nothing. With two injections of 0.2 c.c. repeated twice infection ceased. Previously, up to the time of the injections the patient had been under the action of sulfonamide administered orally.

Puga[34] also mentions good results obtained from intravitreous injection of neoprontosil in a case of abscess of the vitreous. He also reports having obtained a cure of an ulcer with hypopyon following chronic dacryocystitis. After irrigation of the lacrimal sac with the same neoprontosil, the dacryocystitis disappeared and cure of the ulcer was effected within a few days.

The treatment of dacryocystitis with lacrimal-duct irrigation with sulfonamide solutions certainly causes an improvement and sometimes even a temporary cure of the infection, the secretion disappearing. Definite results, however, are less noteworthy, for if there is no permeability of the excretory lacrimal pathways, inflammation recurs within a short time. In cases wherein the pathways are permeable, however, irrigation with a solution of sulfacetamide or with other similar solutions effect very good results.

In acne rosacea, the lesions of the skin of the face may extend to the skin of the lids. Of an unknown origin, this disease responds unfavorably to various therapeutics. Generally, the external manifestations of the disease which cause the greatest discomfort to the patient are not really the result of the disease but of the staphylococcic infections that occur. For these cases Wise[49] recommends the use of 5-percent sulfathiazole or sulfadiazine ointment applied locally several times daily.

Adequate use of the sulfonamides in the treatment of ocular diseases, with attention to proper indication and in the doses which clinical experimentation has found advisable, is a decisive element of unquestionable value in the therapy of a large number of pathologic conditions of the visual apparatus. The possibility of

the effective local use of the sulfonamides in ophthalmology has opened up new fields, and in the future it is possible that the use of these drugs will be even more generalized.

Summary

The fact that the sulfonamides are almost innocuous to the ocular tissues when applied locally, their easy penetration when thus applied, the almost complete absence of symptoms of intolerance to this kind of sulfonamide therapy, and the great effectiveness with which the drug acts in several eye diseases make it probable that the topical use of sulfonamides will largely supplant their oral administration.

Sulfanilamide, sulfathiazole, sulfadiazine, and sulfapyridine, especially the former three, are of generalized use for topical therapy in ophthalmology. The fact that sulfanilamide is soluble in water only up to 0.8 percent and that the other sulfas are still less soluble explains why at first, when only aqueous collyria were tried, local sulfonamide therapy did not make headway. Insufflation of powdered and microcrystal sulfonamides, their local application in properly chosen ointments, the use of sodium derivates, which are more soluble, the previous use of substances which break the surface tension and thus propitiate a larger penetration of sulfonamides through the cornea, the use of iontophoresis and other methods have been tried subsequently with good results and large concentrations of the drug in the ocular tissues are obtained, higher, indeed, than the concentrations achieved when oral or parenteral administration is used. Moreover, this high concentration is reached in a very short time. The possibility of combining local treatment of immediate effect and general treatment of delayed but constant effect is advantageous. Association of fever therapy increases the penetration ration of the drug. So does local inflammation.

Since sulfonamides have only bacteriostatic action, it is essential that the drug be applied frequently; repeated instillations, application of suitable ointments, and iontophoresis appear to be the choice methods.

Phenomena of general intolerance for the sulfonamides during their topical use have not been mentioned so far. Local intolerance revealed by lid dermatitis and conjunctivitis has been mentioned; it always subsides as soon as the treatment is discontinued.

Therapeutic indication for sulfonamides locally in virus diseases is: in cases of inclusion conjunctivitis and trachoma. In the latter, combined simultaneous massage and iontophoresis of the palpebral conjunctiva with the electrode, thus effecting drug penetration and at the same time destruction of the folliculi mechanically, have given good results.

In gonococcic conjunctivitis good results have been reported from the local use especially of sulfadiazine and sodium sulfacetamide. The seriousness of the disease, however, justifies combined local and oral treatment. In cases of streptococcus, pneumococcus, and Koch Weeks inflammations of the eye, sulfonamides are effective but have not proved themselves better than the other therapeutic agents, except in cases of corneal involvement, where iontophoresis is paramount. But in blepharitis, conjunctivitis, and corneal involvement due to staphylococcus, the topical use of sulfonamides is far superior to any other treatment. Thus in conjunctivitis, in general, the local use of sulfonamides is justified as a routine treatment.

Ocular inflammation due to B. pyocyaneus has been treated with success with local applications of sulfonamides, especially with iontophoresis of sulfadiazine.

Inflammations due to B. coli, B. proteus, and K. friedlanderi have also responded favorably to local sulfonamide therapy.

Prophylactically, before and after ocular operations, the use of collyria of highly soluble sodium sulfacetamide has been advantageous.

Innocuous injections of sulfonamide solutions into the anterior chamber and into the vitreous chamber have been reported, apparently with good clinical results.

Local sulfonamide therapy is very effective in a number of well-defined eye diseases, provided proper dosage and adequate means of administration are used.

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DACRYOCYSTITIS: THE PART PLAYED BY SYPHILIS IN ITS ETIOLOGY

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In the ophthalmologist's daily routine, inflammation of the tear-ducts is a fairly common finding. When a search is made for the underlying cause, it is usual to find that the trouble started, not in the lacrimal sac itself, but rather in the duct—because something had occurred to obstruct the duct. When any of the body's secretions are held back, multiplication of the retained bacteria is the regular result. The inflammatory condition thus induced, may, however, be due to any one of many causes; when it becomes chronic, it is often extremely difficult to control. Under such circumstances we must delve deeper into the etiology, for local measures of relief are of no lasting value if we do not know the precise nature of the infection with which we are dealing.

Relation of lacrimal-tract infections to nasal disease. The lacrimal apparatus, on account of its close relation to the nose, is likely to be involved in any disease condition affecting the upper respiratory tract. Because this fact is clinically established, rhinologists and ophthalmologists (if they are consulted) often assume, in any lacrimal-tract disturbance, that nasal-sinus disease is the underlying factor, and so make no further investigation.

Congenital malformation. Old-school ophthalmologists referred most pathologic conditions of the lacrimal apparatus to congenital malformation. The modern textbooks do not lay so much stress on anomalies of structure, but there is no doubt that malformed organs in any part of the body are more prone to disease than completely normal ones. Schnyder, writing in 1920 (which ranks him with the moderns), gave examples of hereditary disease of the lacrimal apparatus which he demonstrated were dependent upon anomalies in the conformation of the nasal bones. Such anomalies can be passed on from one generation to another. Schnyder's argument was that the osseous portion of the lacrimal canal—that is, the lacrimal bone itself—the ascending portion of the maxilla, and the lacrimal process of the inferior turbinate—all being parts of the facial skeleton—have definite forms for races, families, and individuals, so may vary exactly as do the shapes of nose or temporal bones. If the lumen of the lacrimal canal is abnormally contracted because of bony malformation, individuals or families presenting this anomaly will be prone to have "watering eyes."

Congenital lymphoid-tissue hypertrophy. Other writers—for example, Meller—incriminate lymphoid tissue rather than bony structures. If an overgrowth of such tissue exists—and this tendency to lymphoid-tissue hypertrophy may well be inherited—any infection or other stimulation might cause swelling which would close off the lacrimal canal and so induce dacryocystitis.

Determination of the active infective agent. But even if we accept these etiologic concepts we are still confronted with the necessity of determining the active causal factor. My attention was particularly drawn to this phase of the subject by two patients who came under my care on account of a dacryocystitis on the left side. The histories are as follows:

CASE 1. Because of a painful swelling of the

left eye and left side of the nose, a housewife, aged 54 years, presented herself for examination. She stated that for three months previously there had been a discharge of pus, with periodic swelling at the inner canthus on the left side. The swelling had been opened and drained several times, but the lesion had remained obstinate to treatment.

Examination showed the vision to be: R.E. 6/7.5; L.E. 6/12 (uncorrected). There was swelling at the left inner canthus, so great as entirely to obliterate the outlines of the lacrimal fossa. The swelling on the left side of the face extended downward as far as the mandible, and there was preauricular and cervical lymphadenitis. Routine laboratory examination reported a positive Kahn test, and, guided by this indication, intensive antiluetic therapy was instituted, with hospitalization. The patient was discharged cured at the end of 10 days, although two months later it was necessary to perform a dacryocystorhinostomy in order to do away with the troublesome epiphora.

CASE 2. A laborer, 41 years old, came complaining of a periodic swelling of the left side of the face, especially at the left inner canthus. In the past he had been able to reduce the swelling by massage, but at the last attack the affected region had been too painful to permit manipulation, which induced him to seek relief.

Examination showed vision in each eye to be 6/30, but with his present correction, 6/7.5. There was a painful indurated mass over the site of the lacrimal fossa, although the anatomic landmarks were obliterated, and the lymph glands much enlarged. Immediate relief was afforded by drainage of the affected area, and when the laboratory reported that serologic study had revealed syphilis, energetic antileutic therapy was immediately started. Recovery from the eye condition was prompt, and there was no recurrence during the two months we were able to follow up the case.

Syphilis as an etiologic factor. The demonstration of syphilis in both these cases prompted me to attempt to determine what percentage of cases of tear-duct inflammation is due to an underlying luetic infection. I found little on ocular syphilis, while the literature on lues of the lacrimal apparatus was very meager indeed. For example, in the pamphlet on "The diagnosis and treatment of ocular syphilis" issued by the New York Tuberculosis and Health Association in 1943, one finds:

Lacrimal apparatus: A primary syphilitic lesion of the lacrimal gland rarely occurs. Inflammation of the lacrimal gland (dacryoadenitis) appearing in the tertiary stage of syphilis, is characterized by a painless or slightly tender, localized tumor in the region of the gland. Primary and secondary lesions of the tear-passages seldom occur. Syphilitic lesions of the lacrimal sac and nasolacrimal duct may occur in the tertiary stage of syphilis. They are frequently secondary to syphilitic lesions of the adjacent parts, as, for example, syphilitic inflammation of the medial and lower angle of the orbital margin.

HISTORICAL REFERENCES

The oldest work on syphilis of the eye to which I have access—Thomas Hewson's "Observations on the history and treatment of the ophthalmia accompanying secondary forms of lues venerea," published in London in 1824—has nothing whatever to say about luetic infection of the tear ducts, although it makes most interesting reading on the general subject of ocular syphilis. Neither is dacryocystitis mentioned as etiologically dependent on syphilis in any of the standard works on ophthalmology in use during the remainder of the nineteenth century. Indeed, the present century was well advanced before such a possibility was recognized by either general practitioners or ophthalmologists in eye work or syphilology.

The 1934 edition of Stokes' "Modern clinical syphilology" discusses Mikulicz's syndrome, which is defined as "a chronic symmetrical painless enlargement of the salivary or lacrimal glands." We are told that its "etiology is probably a chronic infection, tuberculosis and syphilis having been demonstrated in some cases." A canvass of the literature shows that primary syphilis was occasionally demonstable in the lacrimal gland, the dacryocystitis being secondary to it. Such a case was reported by Anargynos in 1901. Tuberculosis of the inner canthus was the first diagnosis. Simultaneously with the swelling of the gland, hypertrophy of

the conjunctiva occurred, there was a scattering of small yellowish nodules which later coalesced, and an accompanying adenitis in the preauricular lymph glands. The lacrimal gland was removed, but pathologic study showed no tuberculosis. Four weeks thereafter the patient's body displayed a papulomacular exanthema, with generalized lymph-gland involvement. All the manifestations promptly subsided under antiluetic treatment, which in 1901 was considered proof positive of syphilitic infection.

The 36-year-old woman seen by Luedde in 1911, gave a history of "'an abscess of the corner of the left eye' of 4 or 5 weeks' duration." Examination showed what appeared to be "an ordinary inflammation of the lacrimal sac, except that the bulk of the swelling was higher than usual." But the therapy usually efficacious in dacryocystitis had no effect. Three weeks elapsed and the patient "even seemed to be getting worse." An inquiry into the woman's social antecedents offered a syphilitic infection as a possible explanation. Acting upon this hint, Luedde pushed antiluetic measures, with immediate subsidence of all the ocular manifestations. The author remarks, "It is evident that we were dealing here with a gummatous process springing from a latent lues of long-standing. The location of the trouble, together with the subjective symptoms (overflow of tears, excessive secretion, swelling, and others), and the rarity of luetic processes of this type obscured the diagnosis."

Is the left eye more commonly effected? Inasmuch as both my own patients suffered from infection of the *left* lacrimal duct, it has been of especial interest to me to note that all the preceding cases were of leftsided dacryocystitis. I can see no reason why the left side should be more often involved and the fact is probably only coincidental, but it will be of interest to note, as such cases are more often reported, whether or not the condition has a predilection for the left side.

In the case of Parker, reported in 1913, the patient was a boy, aged 6½ years, with a history of having suffered since six months of age with bilateral purulent dacryocystitis. The author tells us,

> . . . We believed the case to be one of congenital obstruction of the ducts. These cases usually depend upon failure of complete absorption of the epithelial cord, which . . . in the embryonic state is developed from an ingrowth from the epithelial surface. Such cases are usually unilateral and are characterized by overflow of tears and acute attacks of dacryocystitis beginning shortly after birth. They are generally completely cured by the passing of probes, rupturing the occluding membranes. This child was treated in this manner, but after prolonged probing, the treatment continuing many weeks, and failures to secure drainage, both lacrymal sacs were removed, with a complete cure of the dacryocystitis.

Syphilis was not, however, suspected until four years later, when the boy returned to the hospital with a severe interstitial keratitis. At the time of this second entrance, the routine examination included a Wassermann test, which gave a strongly positive reaction. Profiting by this experience, Parker had a Wassermann done on another child who just then came in with an acute dacryocystitis, and secured an equally positive reaction. He remarks that he had learned the lesson that "in all cases of bilateral epiphora or dacryocystitis coming on without definite history" a Wassermann test should be made.

The discovery of the Wassermann test facilitated the detection of a luetic origin in all sorts of eye affections, just as it did in almost every other field of medicine. In 1914, Igersheimer published a series of cases wherein hereditary syphilis had affected the lacrimal apparatus. He pointed out that many instances of dacryocystitis wherein the cause had been attributed to

nasal infection, were in reality cases of hereditary syphilis of the upper respiratory tract, either in the submucosa or the underlying bony structures, which had produced stenosis of the lacrimal passages, with resulting dacryocystitis. The fact that many children so affected also have chorioretinitis, or parenchymatous keratitis—both of which are known to be frequently syphilitic in origin—is a strong confirmation of this theory.

Igersheimer gives a more detailed consideration to the luetic origin of many instances of lacrimal-duct inflammation than any who went before him. He divides the cases into three groups:

(1) Those in which the origin cannot be demonstrated, but the present appearances made it reasonable to assume that earlier in life stenosis of the nasal passages had occurred, resulting in lacrimal-duct inflammation.

(2) Those wherein syphilitic changes in the nose could not be demonstrated, but there was a history of syphilitic infection.

(3) Those wherein a "saddle-nose" or other nasal deformity associated with syphilis existed as positive proof of the etiology of the lacrimal-tract involvement.

In 1915, Potter told the members of the Laryngological Section of the Royal Society of Medicine of London of the case of a girl aged 12, concerning whom no history of her previous condition was obtainable, "since the child was sent to me from a work house infirmary." On examination of the child after she reached the hospital, widespread destruction of the septum and left side of the nose was discovered, while the uvula was entirely absent. We cannot, today, share the surprise of both speaker and audience that a bilateral dacryocystitis should have resulted under such circumstances.

The thesis that Guilini presented at Munich in 1914 concerned luetic infection of the lacrimal gland, and in the same year—that in which the first World War began—Dewabripont published a monograph with the imposing title "Contribution to the study of the bacteriological and histological relationships between disease conditions of the nose and of the lacrimal ducts," containing an elaborate classification of the causes of dacryocystitis, the seventh of which was "Syphilis," which, he stated, was regularly secondary to syphilis of the nasal bones. Dewabripont was a Belgian, and probably familiar with Kalt's article in the volume of the "Encyclopédie française d'Ophtalmologie," which was published in 1909. Kalt states that as far back as the days of Boerhave, syphilis of the nose was recognized as being likely to cause blockage of the lacrimal ducts, and subsequent inflammation, and continues by listing four "observations" culled from French literature, namely those of Alexander, Thiry, Galezowski, and Panas.

> . . . Alexander's patient showed osteo-periostitis, necrosis of the maxillary bone, and a fungoid condition of the lacrimal sac; Thiry's had periostitis of the left tempero-mandibular articulation with a syphiloma in the region of the lacrimal sac, all having appeared eight months after the original luetic infection. In Galezowski's case the syphiloma appeared as a secondary manifestation, terminating as gummatous hyperplasia of the anterior wall of the sac. Panas saw a man, aged 45 years, who was infected with syphilis at age 25, but was otherwise in good health. He now presented a huge fungating mass in the region of the lacrimal sac of the left side, which at first sight suggested a cancer. But as he also had characteristic lesions of the tonsils and nasal bones, the true nature of the "growth" was recognized, and everything cleared up promptly when antiluetic measures were instituted.

The author remarks that the only dangers in diagnosing these cases lie in confusion with tuberculosis. And 20 years later we find Kemler making a similar statement, only warning us not to confuse syphilis with foci due to other infections than that of the spirochete.

In 1921 Pais reported a case of "syphilitic dacryocystitis," and from that time forward there was increasing recognition of the importance of this protean disease in lacrimal-tract infection. Reports were published by Treacher Collins (1922) in England; Cowper (1922) and Derby and Cheney (1924) in this country; and in France by Rollet and Colrat (1925), Hudelo d'Allaines and Rabut (1926), and Morel and Gest (1929). The case of Vogt, quoted by several authors, turns out upon translation of the original publication to have been attributed not to syphilis but to gonorrhea. However, Fahmy, an Egytian, writing *in extenso* on the etiology of dacryocystitis, makes but a brief mention of the spirochete as having appeared in any of his microscopic investigations. And Desvignes, as recently as 1938, remarked that he believed it his duty to publish his clinical history of a 36-year-old woman "because of the rarity of these cases and the importance of establishing an exact diagnosis in order to institute an etiologically rational treatment."

The most recent paper to come to my attention, in which mention is made of the etiologic importance of syphilis in dacryocystitis, is that of Garfin published in January, 1942. In sharp contrast to earlier writers, he states that "syphilis not infrequently occurs as a primary disease of the lacrimal sac, or of the skin overlying it. It may also extend from the inner canthus to involve the sac." He adds, "Through obstruction of the lacrimal canal, syphilis may lead to non-syphilitic dacryocystitis," and he concludes by mentioning that among his first 25 operations on lacrimal sacs he found two external fistulae due to acquired syphilis.

An examination of textbooks, recently published or revised, provides no more information on which exact percentages might be based. Tassman in his "Eye manifestations of internal diseases" (1942) says, "Dacryocystitis . . . may result from cicatricial contraction following ulcerations occurring in syphilis and tuberculosis." The fourth edition of Neame's "Handbook of ophthalmology" (1942, p. 78) merely states, "Inflammation of the lining mucous membrane of the naso-lacrimal ducts is catarrhal, tuberculous or syphilitic . . . occasionally syphilitic periosteitis . . . for tumors of the upper jaw may cause obstruction by external pressure on the nasal duct," resulting in dacryocystitis.

Summary

1. Inflammation of the tear ducts is frequently referred to accessory-nasal-sinus disease, and the possibility of other etiologic factors overlooked.

2. Nineteenth-century ophthalmologists considered congenital anomaly of the facial bones or of the lymphoid tissue of the lacrimal region capable of furnishing an enviroment favorable to dacryocystitis.

3. When treated by antiluetic measures, two cases of acute dacryocystitis seen by the author promptly subsided. This led him to attempt to determine the percentage of cases of tear-duct inflammation that could be traced to syphilis.

4. A review of literature disclosed but a few recorded instances of proved syphilitic dacryocystitis, and, as late as 1938, the "extreme rarity" of the condition is emphasized.

Conclusions

In comparatively few cases of dacryocystitis has syphilis been recognized as the etiologic factor. It is probable that more careful laboratory examinations might reveal many unsuspected cases.

Therefore, it would seem desirable that serum tests become a regular part of the examination in all cases where the causal factor is in doubt.

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NOTES, CASES, INSTRUMENTS

THE USE OF SCLERAL RESECTION IN HIGH MYOPIA*

REPORT OF A CASE

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Loss of vision in cases of high myopia associated with progressive degenerative changes in the retina and choroid is not uncommon. It is usually so slowly progressive that the patient is not aware of any sudden decrease in the vision; and occasional changes in the patient's glasses are sufficient to relieve the individual. On rare occasions, however, the ophthalmologist is faced with the problem of treating a malignant myopia, with degenerative changes, in which the patient is keenly aware of the rapid failure of vision, and changes of the lenses are of no benefit. Such loss of vision may occur over a period of weeks or several months and may incapacitate the patient to the extent that he is desperately in need of help.

Scleral resection in such desperate cases was suggested to one of us (W. E. B.) in 1934 by Lindner; but he stated that he had never attempted such a procedure in the absence of retinal detachment.

A review of the literature reveals only sporadic accounts of operations performed in these cases of high myopia in which other complications indicating surgery were not present. Müller,[1] Elschnig,[2] Lindner,[3] Pischel,[4] Borley,[5] and others, however, have had rather gratifying results with scleral resection in more or less hopeless cases of retinal detachment in which previous operations had failed and in which myopia was the underlying disease. Arlt, Wolfe, Perinaud, and Galezowski are reported by Hildesheimer[6] to have attempted shortening the eyeball by excision of a band or bands of sclera to relieve high myopia and to improve retinal detachments in myopic eyes. Results were apparently very unsatisfactory, and there were many serious complications which made these procedures useless.

In 1903, Müller[1] described his operation of scleral resection for retinal detachment in high myopia, and Lindner later modified this procedure. In 1911 Holth[7] presented an operation for reducing myopia by trephining the sclera in the preëquatorial region. He reported results of his operation in seven cases of retinal detachment and in two cases of high myopia in which no detachment existed. He claimed a shortening of the anterior-posterior axis of the globe was produced and a reduction in the degree of the myopia; but he gave no report of visual improvement.

In 1926, Müller[8] presented another operation for decreasing myopia by severing the superior oblique muscle. He reported 25 cases, 21 of which were in highly myopic patients. The results in these cases were said to be a negligible motor loss, enophthalmos of about 3 mm., decrease in the degree of myopia by 3 to 6D., retrogression of the retinal and choroidal changes, and improvement of visual acuity.

In 1937 Hildesheimer[6] reported the use of the electric cautery, in the form of a loop, to excise sclera for the reduction of myopia. He recorded two such cases, in each of which there was a unilateral high

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myopia, one complicated by exophthalmos, and the other, by a grayish prominence of the peripheral retina which he called an imminent detachment. Both eyes so operated upon were reported to be improved.

Spaeth,[9] in the latest edition of his textbook on ophthalmic surgery, devotes a page to "Scleral surgery for high myopia," and considers Lindner's recommendations for scleral resection. However, he gives no report of any use of the operation in the absence of retinal detachment.

Thus the problem of treating a severe and progressive myopia with degenerative changes and rapid failure of vision has been only occasionally reported as successful. It was therefore thought that the following report of a case with the technique used and the visual improvement noted might add to our present knowledge of high-grade myopia and the possibilities of a method of successful surgical treatment.

Case report

Miss P. E., a white nurse, aged 56 years, entered Stanford Eye Clinic on November 5, 1940, for examination because of a recent disabling loss of vision of several weeks' duration. Vision of both eyes had always been subnormal due to a high degree of myopia, but she had been able to carry on with her nursing with changes in her glasses until several weeks before seeking medical advice. She had worn glasses for nearsightedness since the age of five years. At the time of entry she stated that there had been some loss of vision in the left eye for the previous year, but there had been a more rapid blurring and loss of vision in both eyes during the several weeks previous to entry. She had only recently become unable to read a newspaper, whereas shortly before she had had no difficulty.

At examination the following observations were made: Corrected vision was, right eye, 15/200; left eye, the ability to detect hand movements at 2 feet. Glasses worn were—right eye, −17.75D. sph. ⊂ −1.00D. cyl. ax. 80°; left eye, −18.75D. sph. No change in lenses improved the vision. The eyeballs were protuberant in appearance. Ophthalmoscopically, there were many vitreous opacities in each eye, and the fundi showed irregular pigment accumulations at the posterior poles and large extensive areas of choroidal atrophy with a definite ectatic appearance in that region. The changes were more marked in the left eye. A very restricted eccentric field of vision in the left eye was present to objects of 30 mm. diameter. The visual field of the right eye showed extensive loss, but with retention of some of the central portion of the field (fig. 1).

Considering the seriousness of the find-

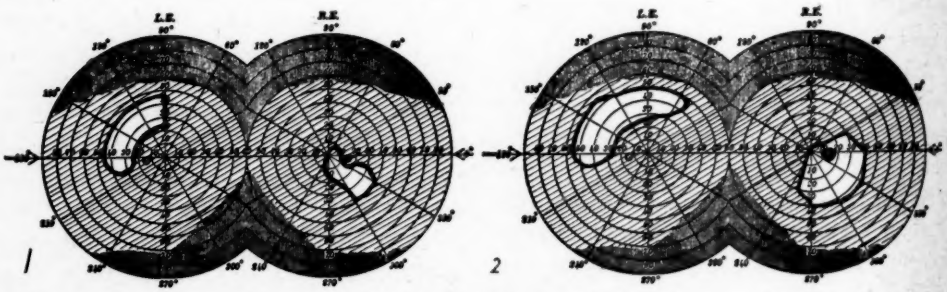

Fig. 1 (Borley and Tanner). Visual fields before operation, January 9, 1941. Test object, 30 mm., white. Field only slightly larger to hand movements.

Fig. 2 (Borley and Tanner). Visual fields three years after operation, September 5, 1944. Test object, 30 mm., white.

ings and the apparent recent rapid loss of visual acuity, it was thought advisable to perform some operation that might prevent further progress of the disease. It was believed that a scleral resection might offer some hope, and operation on the left eye was performed on January 22, 1941. The resection of the sclera was done on the temporal side, 11 mm. posterior to the limbus, from the 12- to the 6-o'clock positions. A strip of sclera 2 mm. wide was removed. The technique was similar to that described in a previous paper by one of us (W. E. B.),[5] with the exception that, in removing the strip of sclera and bringing the sutured edges together, repeated paracenteses were required to allow escape of fluid, with consequent lowering of the intraocular pressure, in order to replace the protruding choroid. It was not considered advisable to puncture the vitreous body to relieve the tension because of the possibility of injuring the retina and causing a retinal detachment.

The postoperative course was uneventful. The field of vision and the visual acuity did not immediately change, but this eye remained essentially the same. Within the next two months there was a progressive loss of vision in the right eye, and it seemed likely that all useful vision might be lost. Scleral resection was proposed for the right eye, and the patient gave her permission. Vision just before operation in this eye was 15/200, with difficulty. There was further limitation of the field of vision.

Scleral resection was done on the right eye on June 18, 1941. A 2-mm. strip was resected as on the other eye, from the 12- to the 6-o'clock positions on the temporal side. The choroid was cauterized with 3-percent sodium hydroxide and the scleral edges approximated with no. 0000 chromic catgut after aqueous had been repeatedly released by means of paracenteses.

The postoperative course was similarly uneventful. The vitreous after several months appeared clearer, and the fundus was more easily seen. The patient stated that her vision had improved and that she could get about definitely better. There seemed to be slight but definite improvement from that time on, and by January, 1943, the condition seemed to have reached a stationary point, with demonstrable improvement in visual acuity and visual fields, particularly in the right eye.

At the time of the last examination on September 5, 1944, the corrected vision was: R.E. 15/70; L.E. ability to count fingers at 2 feet. The glasses worn at the time of entry to the clinic in 1940 could not be improved upon. With a hand magnifying glass, the patient could read Jaeger 8 type print with difficulty with the right eye, and had managed to read part of a newspaper daily for the past year. Visual fields were essentially the same as in January, 1943 (fig. 2). There were no further changes in the fundi, except that in the right eye an area of choroidal scars and pigmentation similar to that seen after operations for retinal detachment could be seen far temporally in the area of the scleral resection.

Discussion

The case just described demonstrates that scleral resections may be successfully used in the absence of retinal detachment. The main point of difficulty arises when the protruding choroid is replaced and the sutures tied. Great care must be used to avoid injury to the choroid with consequent hemorrhage. The simple expedient of anterior-chamber paracenteses repeated at about five-minute intervals during the suturing greatly facilitates the closing of the wound. Cauterization of the choroid with sodium hydroxide is done as in all types of scleral resection. It

is our opinion that cases of this type derive some benefit from this operative procedure, either in improvement or in prevention of further progress of the disease to ultimate total loss of vision from degenerative changes or retinal detachment.

Conclusions

Scleral resection in highly myopic eyes with degenerative changes but without retinal detachment is feasible and possible, without injury to the retina or choroid. With the use of this procedure the progress to blindness from degenerative changes or retinal detachment in these eyes may be delayed or prevented.

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PENICILLIN ADMINISTERED LOCALLY IN GONORRHEAL OPHTHALMIA

Sensitization reaction

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Enthusiastic reports upon the results of penicillin therapy in cases of surgical infection are continuously coming to our attention. Only a limited number, however, record the local use of an aqueous solution of penicillin in the conjunctival sac; nevertheless, they[1, 2, 3] speak of gratifying results.

Since penicillin has established an important place in the treatment of gonorrheal urethritis, it was anticipated that its intramuscular use in gonorrheal conjunctivitis would result in a satisfactory recovery. However, we were anxious to observe the effects of the local application of the drug into the conjunctival sac in a case of gonorrheal ophthalmia. One particular patient was well suited for this method of local treatment because the infection certainly was a fulminating one, although the cornea was intact and showed no immediate danger of sloughing.

In addition to the excellent result which was obtained from the use of this new drug, this case is reported because of the local drug sensitivity which resulted after prolonged use of the solution, and because of the allergic activation of the lids fol-

lowing later intramuscular injections.

The patient, a white man, aged 40 years, was admitted to the Lawson General Hospital on November 2, 1943. He stated that approximately 12 days before admission the right eye had become injected and had gradually become severely inflamed. Ophthalmologic examination revealed vision: R. 20/100, L. 20/15. The lids of the right eye were moderately red, thickened, very firm to the touch, swollen shut, and were so leathery that they were opened with difficulty, and a lid retractor had to be used. Thick, dirty, yellow pus literally flowed from between the lids, so that the cheek required almost constant wiping. The conjunctival sac was filled with thick pus. The palpebral conjunctiva had the appearance of "raw beefsteak." The bulbar conjunctiva was injected and so thick that a ring of depression was produced around the limbus. The cornea was moderately hazy. The pupil was very small and reacted sluggishly to light. A smear made from the secretions was filled with pus cells and gram-negative, intracellular diplococci, morphologically resembling gonococci. The culture was confirmatory. The left eye appeared entirely normal with a minimal amount of conjunctival injection, and during the entire course of the disease remained uninvolved.

The patient admitted having had a recent attack of gonorrheal urethritis which apparently had subsided following sulfonamide therapy. However, a smear made from a mucoid urethral discharge was positive for the gonococcus.

Atropine sulfate, a 1-percent ointment, was instilled once, and four drops of a saline solution of penicillin (500 units per cubic centimeter) were instilled into the right conjunctival sac every hour, beginning at 5:00 p.m. on the same day. At the end of 16 hours, there was marked objective improvement. The vision, even under atropine, had improved to 20/40, the purulent discharge had ceased, the lids were less thick, and the conjunctiva was less elevated. Although upon admission the smear from the conjunctival secretions presented many gonococci, a similar examination made on this second day of treatment revealed a complete absence of the gonococci. Beginning at 10:00 p.m. on the second day of hospitalization the penicillin was instilled every three hours, and on the third day, beginning at 6:00 p.m. the strength of the penicillin solution was reduced to 250 units per cubic centimeter. One drop of a 1-percent atropine sulfate solution was instilled each morning during the first week of hospitalization, following which it was administered every third day. Three days after admission iced normal saline compresses were applied to the right eye four times daily.

Daily smears and cultures as well as occasional conjunctival scrapings remained negative until the seventh day when gram-negative intracellular diplococci were again seen. As a consequence of this finding, the penicillin solution (250 units per cubic centimeter) was again instilled every hour for 12 hours, and, subsequently, was again administered every three hours.

The lids became almost normal; there was only mild ptosis, and, although the bulbar conjunctiva was much less injected, the palpebral conjunctiva was only slightly improved.

On the twelfth hospital day, while the penicillin was still being administered every three hours, the lids of the right eye suddenly became very thick, dull red, and leathery, and the epithelium of the skin surface became slightly fissured. In addition, there was almost complete ptosis of the upper lid. The bulbar and the palpebral conjunctiva remained unchanged. Examinations of smears made from conjunctival scrapings were negative. The

clinical appearance was that of a typical drug sensitivity, and, in view of the fact that the atropine solution was being instilled only twice weekly, it seemed evident that the penicillin solution must be held responsible for this reaction. This solution was discontinued immediately, but the atropine and the iced saline compresses were continued.

Rapid improvement occurred by the fifteenth hospital day. The vision in the right eye, under atropine, was now 20/25. The epithelium of the lids began to desquamate, and bland sterile oil was applied externally. On the seventeenth hospital day the external appearance of the lids was normal, and all local treatment was discontinued. The bulbar conjunctiva had a normal appearance, and the cornea was clear. However, there remained considerable palpebral conjunctival injection of the lower lid, with marked thickening and redness of the inferior fornix. The upper lid was almost normal in appearance. Repeated smears and a culture of the conjunctival scrapings were negative, and zinc sulphate solution (0.25 percent) was instilled, one drop four times daily. One week later the strength of the solution was increased to 0.5 percent. The conjunctiva of the inferior fornix gradually became less injected, and all local treatment was discontinued.

Although no urethral discharge was perceptible, several cultures of the urine were reported positive for gonococci. Consequently, on the 36th hospital day 50,000 units of penicillin were injected intramuscularly as follows: 10,000 units every three hours for five doses. Following the final injection at 8:00 p.m., the lids of the right eye became moderately edematous, with partial ptosis of the upper lid; and the conjunctiva became moderately injected. There was no secretion nor discharge and the smears and cultures of conjunctival scrapings remained negative. This reaction resembled a typical allergic manifestation, which completely subsided in a few days, following the use of iced saline compresses and one drop of a 1 to 1,000 solution of adrenalin hydrochloride four times daily.

After this episode the conjunctival scrapings and urinary cultures remained persistently negative, and the visual acuity was: R. 20/20, L. 20/15. Both the palpebral and bulbar conjunctiva appeared normal and the patient was discharged from the hospital and returned to duty.

Comment. We were encouraged to use penicillin locally in the conjunctival sac after reading the report of M. E. and H. W. Florey[3] upon their success with one patient who had gonorrheal ophthalmia neonatorum.

From our experience in this case it would seem that hourly local instillations of saline penicillin should be continued for a period of 12 hours, followed by instillations at 3-hour intervals. The penicillin should be continued until three successive daily smears and cultures of conjunctival scrapings have been reported as negative. Subsequent use of this drug would depend upon the presence of the gonococcus in future smears or cultures of conjunctival scrapings.

The procedure we followed was prompted by our desire to test the efficacy of penicillin locally and therefore we delayed giving the intramuscular injections. We believe it is safe to say that in a patient with gonorrheal ophthalmia, in the absence of an associated genital infection, one would be entirely justified in applying penicillin in saline solution directly into the conjunctival sac. However, should an ophthalmic and a genital Neisserian infection occur concomitantly, both intramuscular and local therapy would be indicated.

Our patient responded so rapidly to local penicillin treatment, that, except

for the usual hygienic measures, no special attempt was made to protect the other eye. It must be remembered that the solutions of penicillin which we used, namely 500 and 250 units per cubic centimeter, were relatively very weak, and using only four drops, reduced each dose roughly to 125 and 60 units, respectively.

Conclusion

1. An exceedingly severe case of gonorrheal ophthalmia responded to local treatment with penicillin, yielding negative smears and cultures, in less than 24 hours of treatment.

2. Prolonged use of penicillin locally resulted in a typical drug-sensitization reaction, such as occurs in individuals sensitive to atropine or the mercurials.

3. Twenty-three days after local use of the penicillin was discontinued, intramuscular injection of the drug was given for the gonorrheal urethritis. This procedure was immediately followed by a typical drug reaction in the lids of the involved eye.

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VOLUNTARY PUPILLARY MOVEMENTS*

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This case is of interest in that the patient was able to contract or dilate the pupils at will, without imagining fear, excitement, or horror during the demonstration. She stated that she first noted that she could control the movements of the pupils while looking into a looking-glass when she was about 10 years of age. In the cases recorded in the literature, the pupils dilated when the subject imagined something horrible or that great danger was imminent.

In 1931, Petrovie and Tschemolossow[1] described the case of an oculist, aged 62 years, who had for years been able to dilate his pupils voluntarily by imagining something horrible. His health had always been good, but in the last few years he had developed some neurasthenic symptoms. The authors observed and described one such experiment lasting 30 seconds, in which the patient gradually dilated his pupils from a width of 3 mm. to 4.5 mm., with simultaneous increased frequency of the pulse rate from 60 to 72 per minute.

It seems that this phenomenon can be explained on the grounds of the existence of a connection between the cerebral cortex and the pupillary center of the oculomotor nucleus, whereby one can control by the will the movements of the pupil through the action of the sympathetic and parasympathetic fibers in the iris muscles. A similar phenomenon is seen in rare individuals who are able to dislocate the shoulder and hip joints voluntarily by

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merely relaxing the muscles and ligaments surrounding the articulation.

Chauveau[2] (1861), Claude Bernard[3] (1892), and others have shown that stimulation of any sensory nerve results in a dilatation of the pupils. The dilatation does not depend directly on the physical intensity of the stimulus but is a function also of the state of receptivity of the higher centers, for after ablation of the cerebral cortex the reflex is completely lacking. Strong psychical stimuli act in a manner similar to sensory stimuli and under the excitement of extreme interest, emotion, or fear, pupillodilatation is very evident (J. Müller,[4] 1840). The pupil thus forms, as described by Duke-Elder,[5] a delicate psychical aesthesiometer; for every stimulation, be it sensory or psychic, which reaches consciousness tends to bring about a dilatation. For this reason pupillary dilatation occurs during the period of excitement in the induction stage of anesthesia, the pupil is contracted in sleep or in narcosis when such impulses are lacking, and on waking from sleep or anesthesia the pupils dilate to their normal size. Pupillodilatation occurs on stimulating almost any region of the cortex, whereas a pupillary constriction results if the corresponding half of the cortex is ablated (Trendelenberg and Bumke, 1911). The influence of the cortex, therefore, may become effective either through a stimulation of the sympathetic dilatory mechanism or an inhibition of the autonomic constrictor mechanism.

Case report. An unmarried woman, aged 35 years, an Austrian, came to the writer complaining of having found it difficult to read for the past few months. With the right eye vision was 20/30; with the left eye, 20/20. Under mydriasis there were four diopters of hypermetropia. She had orthophoria, as indicated by the objective cover test and the Maddox rod test. Ocular movements were normal in all directions. The near point of convergence was 6 cm. She could overcome a prism 14$^{\Delta}$ base out. Her fundi and fields of vision were normal. Her pupils were equal, regular, and active, and measured 3 to 4 mm. Her irises were light gray in color. She remembered no illnesses; her general condition was excellent. Her parents were well and healthy.

The patient was seated in a comfortable chair in ordinary daylight illumination; her pupils measured 4 mm. She was asked to dilate her pupils—calmly she looked into the distance and one could see the pupils dilate slowly to about 6 mm.; they remained dilated for about 20 seconds, then she blinked her eyes, and the pupils were seen to return to normal size. She was now asked to contract the pupils—she blinked, looked straight forward, and the pupils contracted to about 2 mm., the contraction lasting for about 20 seconds, after which she blinked and the pupils dilated to 4 mm.

My explanation of the phenomenon is that through training, she had developed control of the cortex, dilating the pupils by inhibiting the pupillo constricting center; conversely, by inhibiting the pupillo dilating center, the pupils would contract.

Another explanation that could be offered is based on the "accommodative process"; namely, when she accommodated for distance, the pupils contracted, and upon relaxing the accommodation the pupils dilated.

Summary. A case of a young woman is presented, who, when she looked straight forward was able to dilate and contract her pupils. It is assumed that this reflex speaks for a connection between the cerebral cortex and the pupillary center of the oculomotor nucleus.

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MOTILITY CLINIC*

Intermittent (facultative) divergent strabismus. Its influence on visual acuity and the binocular visual act

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R. F. P., a white boy, aged 19 years, reported for examination because his eyes were "turning out." His mother had had a similar condition ever since she was a small girl; otherwise there was no history of strabismus in the family. The patient stated that the turning of his eyes had not been noticed until three or four years ago. At that time he was given glasses. He is able to keep his eyes straight, but when he does so *"everything blurs."*

Examination. Both eyes were white and quiet; the media were clear; the fundi presented no pathologic changes.

The eyes appeared in a markedly divergent position when the patient fixated a distant object. He used the right eye for fixation, but was capable of changing fixation from one eye to the other at will and on request. He was also able to overcome the divergence of the visual lines by a convergence impulse, but even when he thought that he was keeping his eyes straight there still seemed to be a large angle of divergent strabismus. In the cover test, the angle of squint for distance measured 12 arc degrees, with a varying amount of right hypertropia. The discrepancy between this relatively small angle of squint and the appearance of the eyes, which indicated a much larger amount of divergent strabismus, was explained by measuring the angle gamma on the perimeter; this angle proved to be −12 arc degrees in the right and −8 arc degrees in the left eye. For near, the angle of squint measured 25 arc degrees, again with varying right hypertropia. When a red filter was placed in front of the right eye in the double-image test, the patient reported 12 arc degrees of crossed diplopia with 12 arc degrees of right hypertropia. When the red glass was placed in front of the left eye the localization of the second image was quite uncertain, but an uncrossed diplopia of 4 arc degrees with 1 to 2 arc degrees of left hypertropia was reported. The horizontal and vertical afterimages of a straight glowing filament, imaged in the right and left eye, respectively (afterimage test), were seen alternately in the dark; in the lighted room (negative afterimages), they formed a cross (normal retinal correspondence). On the synoptophore the objective and subjective angles were 24 B.I. with 7 R.H.; there was only momentary fusion, which could not be held. The rotations presented a definite deficiency of the adduction in both eyes, particularly in the left; otherwise they were normal. The convergence movements were jerky, but the near point of convergence was very good (6 to 8 cm.), and convergence was held well.

*From the Clinical Division of the Dartmouth Eye Institute, Dartmouth Medical School. The case described was demonstrated at a staff meeting of the Dartmouth Eye Institute.

Refraction and visual acuity. R.E. −0.50D. sph. ⊂⊃ −0.50D. cyl. ax. 90° = 20/20; L.E. −0.25D. sph. ⊂⊃ −0.25D. cyl. ax. 90° = 20/20. The patient continued to have a visual acuity of 20/20 in either eye, as long as he let the other eye turn out. As soon as he straightened his eyes by a convergence impulse, the binocular visual acuity sank to barely 20/200. If lenses of −2.00D. sph. were now placed in front of the eyes the binocular visual acuity increased immediately to 20/20.

Therapy. An advancement with resection of the left internal rectus muscle was performed. Six weeks after the operation there was a residue of divergent strabismus of 6 to 7 arc degrees. The double-image test showed 3 arc degrees of crossed diplopia with 3 arc degrees of dissociated vertical divergence; the corrected visual acuity was 20/20 monocularly in each eye and 20/30 binocularly. The patient was advised to return for recheck and further surgery (advancement with resection of right internal rectus), but could not do so since he entered the service.

Comment

Cases such as the one reported are usually diagnosed as intermittent or periodical divergent strabismus. They differ, however, somewhat from the ordinary untreated type of intermittent convergent or divergent strabismus in that the patients are able to keep their eyes straight by a voluntary act of convergence. I prefer, therefore, to classify these cases under the heading of *facultative divergent strabismus.*

The near-point of convergence is always excellent in these patients, although the adduction may be quite deficient in each eye.* They are able to overcome the strabismus by a convergence impulse, but not all of them have learned to dissociate convergence from accommodation. These patients—such as the one under discussion—then complain that their vision becomes blurred when they keep their eyes straight. It is easily shown by placing minus lenses in front of the patients' eyes that this blurring is due to an accommodative effort accompanying the convergence effort.

There are some other interesting features presented by the patient. He has a dissociated vertical divergence which is very frequent in patients with alternating divergent strabismus. Furthermore, he shows both normal and anomalous retinal correspondence in the double-image test, depending on whether he fixates with the right or left eye. When the red glass is placed in front of the right eye—that is, when the patient sees the white fixation light with the left eye—he reports a crossed diplopia of 12 arc degrees, which is in agreement with the objective angle of squint. But when the red glass is in front of the left eye and the patient uses his right eye to fixate the white light on the tangent screen, the localization of the red image becomes uncertain and the patient reports an uncrossed diplopia of 4 arc degrees (anomalous correspondence).

Such a change in the sensorial retinal relationship with change in fixation is found not only in cases of facultative divergent strabismus. It may be explained in the following way: Anomalous retinal

* Convergence and adduction should be strictly separated. Convergence is a disjunctive movement, adduction the result of a conjugate movement (dextroversion or levoversion). These two types of movement are controlled by different centers and may be independently affected. Thus, we see frequently an excess of adduction in convergent strabismus combined with insufficient convergence; or we may have a divergent strabismus with deficient adduction but normal convergence. The choice of operation for strabismus should be based on the behavior of the rotations which can alone be influenced directly by surgery.

correspondence is a condition that is acquired on the basis of usage. When the patient fixates with the habitually fixating eye (in this case with the right eye), he uses his eyes in a way that is normal for him and he localizes the second image according to the acquired anomalous retinal relationship. But when he is suddenly forced to fixate with the habitually deviating eye (in this case the left eye), he is faced with unusual conditions. He then reverts to the more or less dormant innate normal correspondence.

In general, patients with facultative divergent strabismus offer an opportunity for many interesting observations with regard to the visual act in strabismus.* In addition to the relationship between convergence and accommodation, which the patients may or may not have learned how to dissociate, there is a whole gamut of possibilities as regards the visual act. When these patients keep their eyes straight they may have normal binocular vision or an imperfect or even only rudimentary binocular coöperation. When their eyes are dissociated they show, as a rule, anomalous correspondence. It depends on the percentage of time during which these patients have a manifest strabismus, how deeply the anomalous retinal relationship is rooted. Since most of them keep their eyes straight a good deal of the time, the anomalous correspondence is usually only superficially established. As a consequence, various phenomena pointing to the instability of the anomalous retinal relationship are frequently observed, such as a change in the retinal relationship with change in fixation.

With respect to the therapy I feel that these patients should always be operated upon, since they frequently have considerable eye fatigue, headaches, and difficulties in close work. Orthoptic exercises prior to the operation are unnecessary. The patients have excellent control over the position of their eyes and anomalous correspondence is usually only superficially established. Nor is it necessary to teach them how to dissociate convergence from accommodation, since they will not have to exert an undue convergence effort after successful surgery. Operation in these cases produces most gratifying and often spectacular results. The patients are relieved of their subjective symptoms; they are unable to dissociate their eyes any longer and, as a rule, soon acquire normal binocular vision. If necessary, this process can be hastened by postoperative orthoptic exercises. The operation of choice in uncomplicated cases is invariably some type of shortening operation of the internal rectus muscles.

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*Tschermak, to whom we owe much of our knowledge about anomalous retinal correspondence, has himself a facultative divergent strabismus and has reported his self-observations in a classical paper.[1] A case of facultative divergent strabismus, showing some similarities with the one presented here, was discussed earlier.[2]

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SOCIETY PROCEEDINGS

EDITED BY DONALD J. LYLE

COLORADO OPHTHALMOLOGICAL SOCIETY

December 18, 1943

DR. C. A. RINGLE, *president*

QUESTIONABLE RETROBULBAR NEURITIS

DR. W. H. CRISP reported that Mrs. B. S. T., aged 27 years, complained on December 5, 1943, of failing vision in her left eye to such an extent that only the upper half of objects was visible. She was seen again on December 8th, at which time the left eye was tender to palpation. There was also some soreness on movement of the eyeball. She had had a cold which affected the left side of the nose particularly. The vision of the left eye was reduced to ability to see light. The pupil reacted very slightly on direct illumination, although indirect reaction was good.

Examination of the nasal cavity, sinuses, and throat was entirely negative. Neurologic examination showed no signs of systemic disturbance except for some slowness and fatigability of the abdominal reflexes, which sometimes is a very early sign of multiple sclerosis.

The patient was given 30,000,000 typhoid-paratyphoid by intravenous injection on December 9th, and 40,000,000 on December 14th. Good febrile reaction was obtained each time.

The pupil had become somewhat more active. The vision of the left eye improved slightly although limited to the upper half of the field. The left eyeball was no longer sore on pressure.

Discussion. Dr. Leo Davis said he thought that this patient had a possible retrobulbar neuritis, probably a result of the cold infection.

QUESTIONABLE DETACHMENT OF THE RETINA

DR. C. E. SIDWELL said that C. L. M., aged 35 years, sustained a penetrating injury to the left eye while using a hammer and chisel. There was considerable hemorrhage into the anterior chamber. Some vitreous escaped through the wound, which was on the nasal side behind the ciliary body.

The foreign body was localized and removed through the wound. The vision was 20/60 after removal of the foreign body but continued to fail until the patient was able to see only light. The iris was bound down by dense adhesions.

COMPLETE ATTENUATION OF RETINAL VEINS WITH MARKED NARROWING OF ARTERIES

DR. JAMES M. SHIELDS reported that Mr. F. H., aged 44 years, suffered a blow to the right side of his head in October, 1943, when a tractor he was operating in Honduras was involved in an accident. He also sustained injury to the side of the abdomen, and both legs were badly lacerated. He disregarded the injuries at the time but about five days later he appeared at the Infirmary and complained that the right eye was red and painful. The eye was examined and the conjunctival sac was irrigated.

The following day the patient complained of a cutting sensation in the right eye. Treatment consisted of the use of castor oil in this eye. Within a few days the vision of the right eye began to fail. He was told that this resulted from the use of castor oil. The patient was transferred to a hospital in Los Angeles and a diagnosis of iridocyclitis, right eye, was made. A careful search for a possible focus of infection was made, and tonsillectomy was advised. The Wassermann test was negative. Treatment consisted of salicylates and atropine instillations.

When the patient was seen again there

was no conjunctival nor pericorneal injection. The pupil was round and fully dilated. The eyeground showed no veins, only what were thought to be venous walls, which showed as white streaks. The arteries were small and showed no light streaks. The visual field was reduced to a small area on the temporal side; there was no central vision. Visual-field examination was made by use of the Finnoff transilluminator.

Two months had elapsed since the onset of the condition. There probably had been absorption of the hemorrhage usually seen in venous thrombosis. The cherry-red spot, seen in the macula in arterial obstruction, had evidently disappeared. The onset of blindness was gradual, as is frequently observed in venous obstruction.

Ocular injury

Dr. C. O. Eigler reported the case of R. W., aged 14 years. On May 22, 1943, while at play, he was accidentally struck in the right eye by a BB shot. The shot struck the cornea below the center but did not penetrate the eye. There were hemorrhage into the anterior chamber, partial dislocation of the lens upward, and an iridodialysis below.

The eye remained quiet and there was no pain. The vision R.E. was 5/60. Treatment consisted of atropine instillations and hot compresses.

Discussion. Dr. John C. Long said he thought that the iridodialysis should first be repaired and then the lens removed or needled.

Accidental gunshot wound

Dr. W. A. Ohmart reported the case of S.K., aged 14 years, who suffered multiple gun-shot wounds to the arm, shoulder, and right eye in a hunting accident, on November 23, 1943. One shot penetrated the right eye at about the 1-o'clock position, just outside the region of the ciliary body.

A conjunctival flap was made, closing the wound. The usual postoperative treatment of atropine, cold compresses, tetanus antitoxin injection, and later foreign-protein therapy, was instituted. It was very difficult to see the fundus, however, because of vitreous hemorrhage. The lens appeared clear.

X-ray report revealed that there were seven particles of shot in the region of the right side of the face anteriorly. Only three of these were possibly capable of having damaged the right eyeball. Two of them were apparently within the right orbit just beneath its roof. None of these was so situated as to be within the eyeball. It was not believed that any one of them had entered the cranial cavity.

The problem encountered was what type of future treatment would be most beneficial.

Discussion. Dr. W. H. Crisp said he thought it advisable to use conservative treatment in an attempt to save the eye.

Glaucoma

Dr. Donald H. O'Rourke presented the case of Mr. J. F. Y., aged 42 years. The left eye had been enucleated 2½ years ago. A brief history of the left eye follows:

In June, 1940, the patient had had an acute attack of glaucoma. He was admitted to the eye service of one of the mid-western hospitals. Permanent operation on the left eye was deferred because it was recognized that there were extensive chorioretinal changes in the right eye. Consequently 12 paracenteses of the anterior chamber were performed during a period of three months. Finally a fistulizing operation (the type could not be determined) was attempted, which resulted in failure, and ultimately enucleation was necessary.

In addition to the chorioretinal changes in the right eye, some of which involved the macular area, the patient had a chronic simple glaucoma. The tension was 41 mm. Hg (Schiøtz). The vision was 20/50 with +1.00D. cyl. ax. 180°.

This patient was presented to illustrate two points: First, that undoubtedly the procrastination in operating on the left eye, resorting to numerous paracenteses instead, was an unsound surgical approach to the problem.

Second, this case presented the necessity of determining whether the progressive loss of vision in the right eye was due to the chorioretinal changes with some minute hemorrhages in the macula, or to the elevation in tension, or both.

Careful central-field studies, frequent recording of the intraocular pressure, and hospitalization for careful physical checkup were instituted.

While the patient's general medical possibilities were being studied the tension in the right eye responded to 1-percent pilocarpine used four times a day. The tension taken on several occasions was from 17 to 20 mm. Hg (Schiøtz).

These findings may delay, but only temporarily, operation on the eye.

Walter A. Ohmart,
Secretary.

MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

December 14, 1943

Dr. J. W. McKinney, *presiding*

Sarcoma of iris

Dr. E. C. Ellett reported two cases of sarcoma of the iris:

The first patient was D. H., a man, aged 56 years, who was seen in consultation in April, 1943. He had had several attacks of pain and inflammation in the left eye for the past two weeks. The right eye was normal. Vision in the left eye was normal. The lower part of the iris from the 5- to the 7-o'clock position was thick and gelatinous looking. Vessels were seen in the growth and on the surface. The iris was involved from the pupil as far back as could be seen. The tension was normal. The eye was otherwise normal. Enucleation was performed. The growth was a malignant melanoma, spindle cell, subtype B.

The second patient, Mr. H., aged 53 years, was seen in consultation in July, 1943. He said that for 15 years he had had occasional hemorrhages in the front of the right eye which blurred his vision. The vision was normal. For three years he had noticed a yellow spot in the iris. There was a gelatinous mass involving the nasal half of the iris from the root to within 1 mm. of the edge of the pupil. This mass extended from the 2- to the 5-o'clock position. The tension was normal. The eye was otherwise normal. Enucleation was advised, but the patient did not return nor has it been possible to trace him. He had had the same diagnosis and advice a month before this examination.

A case of sympathetic ophthalmia with recovery of both eyes

Dr. E. C. Ellett presented C. S., a boy aged 10 years, who was seen on March 27, 1928, and stated that on December 1, 1927, he had been struck in the left eye by a nail. The eye was penetrated but no foreign body remained in it. He received treatment and seemed to be recovering, but about two weeks before he was seen the vision began to blur in the right eye. The eye was painful but not sensitive to light. Both eyes showed some ciliary injection, no photophobia, and the tension of the left eye was questionably elevated to palpation.

R.E. The pupil was adherent all around, 4 mm. in size, and inactive. There was a thin film of deposit on the anterior capsule. A good reflex was obtained, but no details of the fundus could be seen. The vision was 20/70, somewhat improved by +2.50D. sph.

L.E. There was a corneal scar parallel to the limbus below, from the 5- to the 7-o'clock position. The pupil was oval and adherent. The iris showed several dark areas which protruded. These were atrophic spots, pushed forward by confined aqueous. X-ray examination was negative for foreign body. The condition appeared to be sympathetic ophthalmia.

Autohemotherapy was given, 7 c.c. of the serum injected. Atropine was instilled, and the patient put to bed. The eyes cleared, and on April 2d the vision was R.E. 20/20, L.E. 20/50, with correction. The fundus of the right eye was visible. The tension was R.E. 6 mm., L.E. 16 mm. Hg (Schiøtz).

On April 11th the vision of the right eye was reduced to the ability to see hand movements. The eye was red and painful. Iris bombé was present. The left eye was unchanged. Diphtheria antitoxin was given daily for a week in doses of 10,000 units. On April 18th, the vision of the right eye was 20/200. The condition did not change during the summer. In October the right eye showed slight ciliary injection; the pupil was small and filled with exudate; and the iris was pushed forward in several spots. The left eye had not changed. In July, 1929, the vision was: R.E. 20/50 and J12; L.E. 20/30 and J1 with glasses. The eyes were white. Local treatment, which had been continued, was stopped.

In September, 1943, when the patient was seen for the last time, the vision was: R.E. 6/18 and J12 with glasses; L.E. 6/9 and J1 with glasses. The right eye was white. The tension was normal. There was one anterior synechia in, and a smaller one down and out. The pupil was active. There were many pale K.P. below. In the left eye there was an adherent leucoma below. The pupil was a vertical slit, but active. There was some deposit on the lens capsule.

This boy was seen by several consultants and opinions had differed as to whether the left eye should be removed. Some advised it, but it seemed to offer his best chance for vision, and was retained with the present happy result.

Glaucoma with unusual visual fields

Dr. Philip M. Lewis presented B. C., a colored man aged 74 years, who had first been seen a few days previously because his vision had been failing for a period of three years. It had recently become very difficult for him to get about without stumbling over things. The vision was reduced to 10/200 in each eye with glasses. The eyes were free from congestion, and the pupils reacted sluggishly. There were early central opacities of both lenses. The tension was 45 mm. Hg (Schiøtz) in each eye, but the discs were not cupped. They were rather pale, and the retinal vessels showed considerable sclerosis. No hemorrhages nor other abnormalities were found in the fundi. The visual fields were reduced almost to the point of fixation, the left slightly narrower than the right. The general physical condition was satisfactory, blood pressure was 180/100, the blood Wassermann test normal, and X-ray pictures of the skull and sella turcica normal. The intraocular pressure had remained high in spite of treatment with pilocarpine, eserine, and prostigmine.

Comment. While glaucoma may cause marked concentric contraction or "gun-barrel" visual fields, they are rather unusual. If they were due to increased intra-

ocular pressure, the discs would certainly show some cupping. It was thought that in this case the poor vision and contracted fields were due to neither the glaucoma nor the incipient cataracts, but to changes in the occipital lobes that were probably vascular in origin. It was felt that operation to reduce the intraocular pressure was necessary but, because of the contraction of the fields, was extremely hazardous.

Progressive exophthalmos of unknown etiology

Dr. Philip M. Lewis presented Mrs. L. N. R., who was first seen in July, 1943, with what was considered an allergic edema of the eyelids. There was no suggestion of exophthalmos. She was advised to omit all cosmetics temporarily, avoid smoke and dust as much as possible, and to watch her diet carefully. When seen again in September there was a definite protrusion of both eyes, the right measuring 19 mm. and the left 20 mm. The orbital tissues were tense and the globes could not be pushed back into the orbits. The lids were edematous and the retinal veins engorged, but there was no papilledema. Two basal metabolic tests had been made and were normal. Her physician reported that her general physical and laboratory examinations were normal. On the suggestion of Dr. Eustis Semmes, who also saw the patient, she had been sleeping with the head of her bed elevated and taking iodides internally. The exophthalmos had increased about 2 mm., but the lids still covered the corneas adequately. X-ray therapy of the orbits and the Naffziger operation have been considered.

Removal of intraocular foreign body followed by hemorrhage

Dr. Philip M. Lewis reported the case of B. E. M., a white man aged 29 years, who was struck in the left eye with a piece of steel on August 24, 1943. When first seen, two days after injury, the eye was only slightly inflamed and the vision was 20/30. There was a wound through the lower lid near the lower punctum. There was also a vertical wound through the conjunctiva and sclera in the 7-o'clock position, 8 mm. back of the limbus. The anterior segment of the eye was normal. There was a little blood in the vitreous and a large foreign body could be seen in the upper temporal quadrant, near the equator in the 2-o'clock position. X-ray pictures confirmed this location.

The steel was removed easily on the first application of the magnet to a meridional incision through the sclera at the equator in the 2-o'clock position. Surface diathermy was applied to the sclera of that area before closing Tenon's capsule and the conjunctiva. The following day the vitreous was rather hazy, but the fundus could be seen faintly. But the next day the vitreous was so filled with blood that no fundus reflex could be obtained. For three weeks the eye has remained in the same condition. The steel particle measured 3.5 by 2 by 1 mm.

This case was reported to provoke a discussion as to why this hemorrhage occurred, how it could have been avoided, what treatment if any was now indicated, and what was the prognosis. Should the steel have been removed by the anterior route or was the technique used faulty?

Episcleritis and scleritis

Dr. Roland H. Myers presented R. B., a white man aged 55 years, who was first seen in the John Gaston Out-Patient Department on October 24, 1942, with a history of failing vision for the past few months. The vision at that time was: R.E. 5/200, L.E. 20/200. A diagnosis of immature cataracts with myopia was made. On October 6, 1942, an extra-

capsular extraction of the right lens was performed. In April, 1943, a peripheral iridectomy and an intracapsular extraction were done on the left eye. On May 10, 1943, the patient entered John Gaston Hospital with chills and fever. Blood smear was positive for tertian malaria. When discharged from the Hospital on May 12, 1943, he had some conjunctival injection in each eye, with discomfort. He was seen the following day, complaining of severe pain in the left eye. Examination of the left eye revealed a tender globe, and the lateral side from the 1- to the 5-o'clock position was a cherry color. The pathologic process was considered to be an episcleritis, and the patient was placed on dionin 5-percent thrice daily, hot applications, and aspirin compound for pain. After three weeks there was no improvement; then salicylates in heavy doses were given, and X-ray therapy of 150 units. The eye continued to be very painful, and the process increased to involve the eyeball from the 1- to the 7-o'clock position. The patient was sent to the Hospital.

General physical and laboratory tests were essentially negative, the Kahn test negative, X-ray studies of gums negative, prostate gland normal, tuberculin test weakly positive. The following treatment was given: hot, moist applications for 30 minutes, thrice daily, followed by atropine ointment 1-percent, and 3 injections of 10 c.c. of sterile milk at 4-day intervals. Very little reaction was obtained from foreign protein. During the Hospital stay, dionin, thyroid, and heavy doses of salicylates were tried, but no results were obtained. Opiates were often needed for the relief of pain. During his stay in the Hospital, a dark discoloration appeared under the conjunctiva at the 3-o'clock position, and gradually enlarged until it reached to 12 o'clock.

On September 1st, O.T. tuberculin was started. The initial dose was tuberculin O.T. 0.25 mg. of dilution No. 2. The entire conjunctiva and sclera were red, and the eye painful. A necrotizing process appeared to be in progress in the upper temporal quadrant. Because of the very weakly positive tuberculin test, large therapeutic doses were given. Increasing doses were given subcutaneously every five days until a dose of 10 mg. was reached. Response to the tuberculin was immediate and by the time the No. 3 dilution was finished the pain had subsided, and the eye was clearing. When last seen the eye was comfortable and practically free from congestion. Where the inflammation had been most severe the sclera was now thin and atrophic, so that the characteristic blue color from the underlying uveal tract was quite noticeable. He was still receiving 10 mg. of tuberculin every two weeks.

MEMPHIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

January 11, 1944

DR. ROLAND H. MYERS, *presiding*

BLOOD STAINING OF THE CORNEA

DR. RALPH O. RYCHENER presented D. S., a boy aged nine years, the cornea of whose left eye was blood stained. On November 14, 1941, the boy had been struck in the left eye with a missile thrown by another youngster, and was treated elsewhere for three weeks with atropine and bed rest. On December 7th, there was blood staining of the cornea of the greenish-gray type with a clear zone at the limbus, giving slightly the appearance of a lens dislocated into the anterior chamber. The tension was elevated, and eserine was prescribed. There was gradual improvement in the resorption of the corneal stain, and two years later there was only a high

central fibrotic area of corneal scarring. However, there was almost complete absorption of the iris, and the ocular tension varied between 35 and 48 mm. Hg (Schiøtz). The vision was reduced to ability to see light. A partial traumatic cataract was present.

It was deemed advisable to lower the pressure surgically in order to retain a good-looking eyeball, and, because of the traumatic aniridia, cyclodialysis was considered the operation of choice. This was performed on November 26, 1943, but was followed by hemorrhage into the anterior chamber, increased intraocular pressure, and secondary blood staining of the cornea. Paracentesis allowed evacuation of some heavy black clot and relieved the oculocardiac symptoms. The prognosis remained undetermined.

Intracorneal hemorrhage

Dr. Ralph O. Rychener reported a case and exhibited a kodachrome slide of hemorrhage into the cornea, complicating a violent interstitial keratitis of luetic origin.

Mrs. A. E. W., aged 44 years, under treatment for syphilis, was seen on March 31, 1941, with an early interstitial keratitis of the right eye. A vascular fringe invaded the cornea from above, the epithelium was edematous, and a dirty-gray, plastic membrane was adherent in many places to the endothelium. The pupil was miotic but dilated to cocaine and atropine. Following the instillation of a single drop of dionin, there was a marked conjunctival reaction associated with hemorrhage from the vessels invading the cornea, causing an area of intracorneal hemorrhage measuring 2 by 4 mm. along the limbus above. This was well absorbed in 24 hours and entirely gone after 48 hours. Blood staining of the cornea is due to an absorption of blood-pigment products from an adjacent subconjunctival or anterior-chamber hemorrhage. True hemorrhage into the cornea can come only from invading blood vessels.

Hemorrhage into the lens

Dr. Ralph O. Rychener reported a case and exhibited a kodachrome slide of hemorrhage into, or blood staining of, the lens. Mr. S. H., a colored man aged 58 years, had been struck in the left eye while cutting wood. When he was seen one week later, the eyeball was red, the anterior chamber deep, a few posterior synechiae were visible, and there was massive hemorrhage into the vitreous. Atropine and aspirin were prescribed.

Seven months later the vision was reduced to perception of moving objects, and the pupil dilated roundly. Mature traumatic cataract with an inferior quadrant of subcapsular violaceous blood staining or hemorrhage into the lens was present. Apparently a rupture of the lens capsule on the inferior or posterior surface had occurred by contrecoup. The patient was not seen again.

Spontaneous hole in the retina without detachment

Dr. Ralph O. Rychener said that Mrs. C. C. C., aged 58 years, had been observed for three years following a spontaneous hole in the retina without subsequent separation. For a month prior to December 16, 1940, she had been conscious of floating spots before the left eye. On that date her vision with correction was 6/6. Vitreous hemorrhage was present which apparently originated from a retinal hemorrhage far out and up at the third branching of the superior temporal vein, where a fresh hemorrhage overlay a venule. Two weeks later the hemorrhage had cleared, but a crescentic tear with a trapdoor tongue was visible in the retina at the original site of the hemorrhage.

The extent of the area involved was approximately one-half disc diameter. Eight days later the tongue had become detached and was visible in the mid-vitreous as a small, round operculum. Serous, subretinal elevation surrounded the hole, and the entire area then involved was the size of the disc. The eye was closely watched, but never thereafter was there any further evidence of separation.

Three months later the serous elevation seemed less marked and the edges of the retinal hole seemed flatter. After a year the retina was entirely reattached about the hole and since then it has been possible to view it only with some difficulty, since there now was scarcely any contrast between retina and exposed choroid. The visual acuity and fields were still normal.

Lashes in anterior chamber

Dr. Ralph O. Rychener reported that R. C., a boy aged 6 years, had been accidentally struck in the left eye with a scissors point. He was seen 30 hours later, and there was a T-shaped laceration of the cornea just inside the limbus at the 3-o'clock position, with iris prolapse. The iris inside the chamber as well as out was covered by a dirty-gray membrane. The prolapse was excised, and an effort made to remove the plastic exudate covering the pupil. This was successfully done, although it was tenacious and of the consistency of old cyclitic membrane, and proved to include four eyelashes. The cornea was closed with intracorneal sutures, and sulfadiazine and foreign protein were administered.

Due to the resistance of the patient to any medication or examination, it was necessary to remove the sutures under general anesthesia. One month later the iris was drawn toward the wound with partial iris bombé. The eye was white but soft. The vision was reduced to light perception.

Corneal transplantation

Dr. J. Wesley McKinney presented the case of R. S., aged 19 years, who was injured in 1926, in a furnace explosion. Both eyes were severely damaged; the left eye was removed four months later. The right eye recovered and retained good vision for a year and a half. The patient was then hit in the right eye and has since been blind.

When first seen in 1938, the vision was ability to see light. Then tension was 40 mm. Hg (Schiøtz). The cornea was slightly edematous and showed a zonular opacity with calcium deposits which occupied the lower two thirds. The rest of the cornea was relatively clear. The anterior chamber was deep; the pupil was active and central; and the iris was tremulous. A red reflex could be seen in the pupil by directing the ophthalmoscopic light through the upper periphery of the cornea. No lens could be seen.

It was planned first to reduce the tension to normal and, if this were accomplished, to perform a keratoplasty to be followed, if necessary, by extraction of the dislocated lens. Consequently, a cyclodialysis was performed above, with some bleeding into the anterior chamber which cleared up rapidly. The tension remained normal for six weeks, when the eye became red and painful.

At examination, a shrunken cataractous lens was found in the anterior chamber; the cornea was edematous; and the tension 2+. In order to keep the lens in the anterior chamber until extraction could be performed, eserine was instilled repeatedly without appreciable contraction of the pupil. Aminglaukosan was then instilled, with marked constriction of the pupil behind the lens. A short Graefe knife incision was made above and enlarged with scissors, and the lens delivered with the aid of a broad spatula. The tension remained slightly elevated

for several months, necessitating a second cyclodialysis, which was performed down and temporally. This controlled the tension. Four months later a corneal transplantation was performed, with tissue from an eye enucleated for sarcoma of the choroid. The graft remained quite clear except during several bouts of increased tension which would cause edema of the graft. The fundus could be seen fairly well and showed widespread atrophy and pigment migration. The final vision was 3/200 for distance and 20/400 on the Lebensohn chart for near with the print held close.

The visual results obtained in this case could in no sense be called good, but this boy who had had only light perception in his remaining eye was now able to get about alone and to read large headlines in the paper.

Malignant hypertension

Dr. E. C. Ellett reported that H. E. M., aged 65 years, who was seen on June 21, 1943, gave a history of failing vision in the left eye since May 3d, and in the right eye since May 4th. Examination showed a slight lens opacity in each eye and sclerosis of the retinal vessels. In the right eye the nerve was swollen two diopters. There were retinal hemorrhages and exudates and a tendency to a star figure at the macula.

Thrombosis of the central retinal vein with secondary glaucoma and recovery

Dr. E. C. Ellett said that Miss H., aged 50 years, who was seen for the first time in May, 1932, had high blood pressure and had had a retinal hemorrhage two months before she was seen. The vision in the right eye was 5/60, left eye 6/6. The right eye showed an obstruction of the central retinal vein, and the tension was 50 mm. Hg (Schiøtz). The fundus was covered with large, dark, flame-shaped hemorrhages, radiating from the disc. The patient received general treatment from her physician, and pilocarpine drops were prescribed for the right eye. The tension declined, and in October it was 18 mm. In November the patient had a vitreous hemorrhage which obscured the fundus but did not disturb the tension. The vitreous cleared in about two months. This patient was seen at intervals, and in August, 1943, the vision in the right eye was about the same as it had been 10 years before. The tension was 16 mm. Hg (Schiøtz). The blood pressure was 220/130. The fundus was dimly seen because of the lens opacity. There seemed to be no retinal hemorrhages, but there were many white patches. The left eye showed copper-wire arteries and arteriovenous compression, but the vision remained normal.

Dr. Ellett said that in his experience this was the only case of secondary glaucoma following obstruction of the central retinal vein in which recovery had taken place.

Obstruction of a retinal arterial branch

Dr. E. C. Ellett reported two cases as follows: Miss B., a nurse aged 37 years, was refracted in 1940 and again in 1942, and the vision in each eye was normal. In August, 1943, she gave for the first time a history of occasional blurring of vision of the right eye, which always cleared, but a few days before this visit it had blurred and remained blurred. The left eye was always normal. The vision was R.E. 3/200, off center. The media were clear but there was an area of retinal edema above the disc, and the superior branch of the artery seemed smaller than the inferior. A paracentesis of the anterior chamber was performed, and amyl nitrite given by inhalation. The

vision improved rapidly and was normal in three days. At that time, the edematous area was of better color and all the vessels were visible except the ascending nasal artery, which was concealed by the edema and appeared farther out, considerably constricted. The nerve was sharply outlined below, but blurred above. There was one linear hemorrhage at the lower edge of the edematous area. The patient had another short blurring spell two weeks later. Her general examination was negative except for a bad tooth, which was removed. Late in September, the vision was 6/6 and J1. The upper half of the nerve was pale, and the superior vessels were smaller than the inferior. The visual field of the right eye showed loss of the lower half from just below the fixation point.

Mrs. W., aged 42 years, a trained nurse and wife of a physician, was seen in August, 1942, complaining that she had been seeing fireworks in the medial side of her right eye for a month. She had had several blind spells in the right eye, especially on stooping or rising suddenly. Sometimes, only the upper nasal field would blur. The left eye was normal, the vision 6/6 and J1. The general physical examination was negative. The patient smoked cigarettes to excess. The right eye showed clear media, slight arteriovenous compression, and mild retinal edema above the disc. The disc was slightly swollen (about 1 diopter). The macula was normal. There was one retinal hemorrhage along the ascending temporal artery, 1 disc diameter from the disc, and up and in there were some fine white dots in the retina. The vision was normal. The patient was given amyl nitrite, and a paracentesis of the cornea was done, for it was thought that the retinal arterial circulation was impaired. She was given sodium nitrite intravenously daily for one week. After 10 days the patient was seen again. She had had one blurring spell, and the retinal picture was unchanged.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

January 3, 1944

DR. SIGMUND AGATSTON, *presiding*

TWO METHODS OF GLAUCOMA SURGERY

DR. FRANK BURCH'S motion picture on this subject comprised the first part of the instructional hour.

LACRIMAL-SAC OPERATIONS

DR. THEODORE S. BLAKESLEY'S motion picture on this subject completed the instructional hour.

MODIFICATION OF THE CORNEAL SECTION IN CATARACT SURGERY

DR. JOHN H. BAILEY read a paper on this subject which has been published in the Journal (1944, v. 27, Nov., no. 11, p. 1253).

Discussion. Dr. George Epstein asked whether the healing period is prolonged with this section.

Dr. Daniel Rolett stated his belief that half the success of a cataract operation depends on a proper corneal section. He has devised a knife which makes, with a single sweep, a corneal incision of any size, the knife barely penetrating the anterior chamber. Details will be published shortly.

Dr. Sigmund Agatston inquired whether this method of making the section is not time-consuming.

Dr. Bailey replied that healing time is shortened and that while at first his method of making the section does take longer, experience permits greater speed. One of the advantages is the reduced danger of loss of vitreous, because each portion of

the flap is sutured before the next one is begun, and there are three smaller openings, temporarily closed prior to removal of the cataract, instead of one large opening.

Intranasal drainage for cure of chronic tear-sac infection

Dr. David Morgenstern believes that enlarging the opening in the tear sac to the same size as the bony opening is the greatest difficulty in any intranasal technique for cure of chronic tear-sac infection. To surmount this difficulty, particularly when the sac is scarred or thickened, it is fully opened first by a transcanalicular incision.

By placing the forefinger over the tear sac, one can feel the bony margin surrounding it as well as an instrument inserted into it either through the canaliculus or through the nasal cavity. Under the guidance of the palpating forefinger, a thin knife passed through the dilated canaliculus cuts an inverted U-shaped incision in the tear sac against the firm backing of the bony lacrimal fossa. A probe is then pushed through the lacrimal bone into the nasal cavity to guide increasingly larger operating hooks, ends bent at 90 degrees, which are slid along this probe through the bone into the sac. Palpating with the forefinger of the free hand at the inner canthus, the operator feels for movement of the largest hook used last. Under guidance of touch, the bony lacrimal fossa is completely broken down. An inverted U-shaped flap is thus freed from its bony attachment. Saline irrigations turn this flap down into the newly formed bony opening.

To combat closure as well as to reduce infection, a large hook, insulated except at its bent end, electrocoagulates the bony opening and the tear sac. The current is applied lightly where the flap has been turned down. This flap helps safeguard the permanence of the bottom of the bony opening and aids in epithelization.

Since there is a minimum of tissue destruction and bleeding, this procedure is performed in the office, the patient leaving after a short rest.

Discussion. Dr. Benjamin Easterman asked how cauterization of the sac is avoided and how stricture due to cauterization of the canaliculi is prevented.

Dr. John H. Bailey inquired whether Dr. Morgenstern had experienced closure of the opening.

Dr. Morgenstern said he found that palpation of the electrode indicates its position and locates the area to be cauterized. If inadvertently an undesired area is cauterized, passage of a long bent needle through it into the bony opening combats possible stricture. Irrigation every 10 days will maintain patency.

The initial placement of a flap at the bottom of the bony opening safeguards against closure of the aperture, but if there is narrowing or a tendency to close, recoagulation will correct it.

Leon H. Ehrlich,
Secretary.

CHICAGO OPHTHALMOLOGICAL SOCIETY

January 17, 1944

Dr. Vernon M. Leech, *president*

Clinical Meeting

Presented by the Department of Ophthalmology, University of Chicago

Progressive nuclear external ophthalmoplegia (Gower and von Graefe)

Dr. William Rosenberg presented F. G., a woman aged 37 years, who was seen for the first time on September 16, 1943, with a complaint of drooping of the eyelids. Ptosis of the upper lid of the

right eye started when the patient was 14 years old. The lid of the left eye began to droop in January, 1943. At that time, severe retrobulbar and occipital headaches began to occur about once a week, associated with an increase in the ocular symptoms. The family history was non-contributory.

No facial asymmetry was noted. The corrected visual acuity was R.E. 20/25; L.E. 20/20. The palpebral aperture of the right eye measured 5 mm.; that of the left, 3 mm. The eyes were parallel in the primary position, and there was great limitation in the range of extraocular movements in all directions. Pupillary reactions were normal. The accommodative mechanism was normal, as was the remainder of the ocular examination. Following the administration of 1 mg. prostigmine as a therapeutic test, no subjective nor objective improvement was noted. Routine laboratory tests gave normal reactions. Neurologic examination revealed nothing further. The treatment was of nonspecific nature.

Traumatic scleral rupture and retinal detachment

Dr. William Rosenberg said that L. A., a woman aged 26 years, was seen on September 9, 1942. She stated that she had struck her right eye with a cosmetic brush two weeks before. She had had mild pain and almost immediate blurring. The vision was R.E. 20/100; L.E. 20/13−4.

Examination revealed a huge temporal disinsertion which extended from the 7- to the 11-o'clock position. The patient was admitted to the hospital and remained at absolute bed rest until September 11th, when a microcoagulation operation was performed. Although the operative reaction was satisfactory, the retina remained elevated in the periphery and the disinsertion did not flatten. On September 25th, five microcutting perforations were made in the sclera and the lower temporal quadrant in an attempt to release subretinal fluid. The patient was discharged on October 8th, and followed in the out-patient clinic. The retina remained elevated temporally, although excessive chorioretinal scarring was noted. The vision was 20/100.

The patient was readmitted to the hospital on November 15th for further surgery, and the following day it was noted that an arcuate scleral rupture was present, parallel to and 8 mm. from the limbus, lying under the inferior- and external-rectus-muscle bellies and extending from the 5:30- to the 10-o'clock position. This rupture was sutured and several cutting diathermy punctures were made in the inferior temporal quadrant to permit escape of a moderate amount of subretinal fluid. Visual acuity improved to 20/40, but there was little improvement in the field of vision; the retina still appeared elevated, although there was no apparent motion on movement of the eye.

The retina remained attached and considerably flattened, although there was slight elevation beyond the line of diathermy application. On December 9, 1943, vision was R.E. 20/30+3; L.E. 20/16. The patient had resumed her normal activities and had noted no further difficulty.

Essential atrophy of the iris, bilateral

Dr. William Rosenberg said that R. T. M., a 10-year-old boy, came to the Clinic on November 10, 1943, complaining of poor vision in each eye since birth. Corrected vision was R.E. 20/30+1; L.E. 20/50+2.

Examination revealed essentially smaller corneas than normal; each measured 9 by 9 mm. The slitlamp showed bilateral extensive scarring, stretching, and atrophy of the irides with shallow chamber

angles, obliterated in places by anterior synechiae. There were many posterior synechiae and pigment proliferations, and many iris holes and pigment deposits on the lenses. The fundi appeared normal. Bjerrum fields, with 3/1000 isopter, were normal. The tension was R.E. 26.5 mm.; L.E. 20.5 mm. Hg (Schiøtz). With the Souter tonometer the tension was 24 and 26 mm., respectively. It was felt that congenital iris colobomata might have been present at birth but that these were now masked by the extensive pathologic changes; or that the changes might have been secondary to prenatal ocular inflammation.

Metastatic meningococcic endophthalmitis

Dr. William Rosenberg presented J. W., a girl aged 18 years, who had recovered from meningococcic meningitis. Treatment had consisted of anti-meningococcic serum and sodium sulfadiazine in adequate doses. Atropine sulphate, homatropine, and hot compresses were used on the eyes irregularly.

On examination, the vision was ability to see hand movements at about 3 feet in each eye. There were dense exudative masses lying behind each lens. Typhoid-fever therapy was instituted, and atropine sulphate was instilled in each eye every 3 hours. Penicillin administered by iontophoresis was given for 25 days, with slight improvement in the right eye within 8 days. After 16 days there was definite evidence of recession of the pathologic process in the right eye, but not in the left, although there was some subsidence of the inflammatory reaction. Improvement continued gradually, and on December 29th, the vision was R.E. 20/30−3; L.E. ability to see hand movements at 3 feet. Light projection was accurate with the left eye, with satisfactory red and green perception.

Tuberculous iritis, bilateral

Dr. Barbara Spiro presented C. C., a Filipino aged 45 years, who had been seen in October, 1942, and who gave a history of failing vision for several months, associated with continuous headaches. The vision was R.E. 20/50; L.E. 20/30, with correction. There was evidence of severe bilateral iritis with almost complete posterior synechiae. Laboratory tests gave negative reactions, and biopsy examination of a lymph gland showed only nonspecific chronic inflammatory changes. Under treatment with foreign proteins and vasodilators the vision gradually improved and, following typhoid-fever therapy in November, refraction under cycloplegia revealed vision of 20/16 in each eye. A satisfactory examination of the fundi was then possible. Pigment clumping and rarefaction of choroidal pigment were noted as well as vitreous floaters in the left eye. Following a course of old tuberculin, starting with .0001 mg. and increased to 2.5 mg., he remained free of symptoms of uveal activity. Biopsy specimen of an enlarged lymph gland in October, 1943, again showed nonspecific chronic inflammatory changes, but tubercle bacilli were found in smears from an inoculated guinea pig.

Kayser-Fleischer ring of the cornea in hepatolenticular degeneration

Dr. Barbara Spiro said that S. R., a white man aged 32 years, had a diagnosis in 1940 of Wilson's hepatolenticular degeneration. One year later a typical Kayser-Fleischer ring was found when he was seen in consultation in the Eye Department.

Sympathetic ophthalmia

Dr. Barbara Spiro presented J. O., a white man aged 64 years, shown before this Society in 1941 and 1942, as a histo-

logically proved case of sympathetic ophthalmia, occurring 25 years after the original injury. The sympathogenic right eye was removed in 1941, when the left eye began to show signs of acute inflammation. Following enucleation the patient was treated with cycloplegics locally, sulfonamides by mouth, and mapharsen intramuscularly. For 23 months there followed a course of slowly subsiding activity in the left eye. There had been no activity for the past six months, and therapy was stopped eight months ago. Corrected vision was 20/20.

Bilateral central choroiditis

Dr. Maurice J. Drell presented I. C. D., a white woman, aged 62 years, who said that since May, 1943, there had been progressive diminution in vision, with metamorphopsia. Vision with correction was 20/100 in each eye. General physical examination was negative except for mild arteriosclerotic changes and bilateral macular disease. The foveas were replaced by funnel-shaped excavations at the bottom of which was seen red mottled choroid with scattered whitish plaques. Surrounding the foveas was a doughnut-shaped area of mild edema. Campimetry disclosed a central scotoma on each side with the 1/1000 white target.

Bilateral hypertensive retinopathy following total sympathectomy

Dr. Maurice J. Drell said that M. J. W., an obese white man aged 42 years, was seen in August, 1943, following an attack of dizziness four days previously, at which time he noted diplopia and drooping of the upper lid of the right eye. Six months previously he had had a spontaneous subconjunctival hemorrhage of the left eye. Except for occasional headaches, no other symptoms were elicited.

The corrected vision was 20/16 in each eye. The lid of the right eye drooped moderately. Fixation with the right eye was preferred, with a 20-degree divergence; with the left eye fixating, the divergence was 15 degrees. Motion of the right eye was limited in all directions except to the right and down. The pupil of the right eye was larger than that of the left, and reacted more slowly. The fundi showed bilateral marked hypertensive neuroretinopathy with papilledema, great arteriolar attenuation, spasms, exudates, and hemorrhages. The blood pressure was 190-200/150-165 mm. Hg.

As it was thought that the patient represented a medical emergency, sympathectomy was suggested. Six weeks after onset, while the patient was at bed rest awaiting surgery, the ophthalmoplegia cleared almost completely within a period of less than 24 hours. Smithwick sympathectomy was performed in two stages. Recovery was uneventful and the patient resumed his work six weeks after surgery. The blood pressure was then 110/84 when standing and 134/96 when recumbent. The external ocular movements were unrestricted. With the red-glass test there was separation of the images only when looking in the extreme left-and-up position of gaze. Hypertensive changes were still present in the fundi, but to a considerably less extent.

Ocular toxoplasmosis

Dr. Maurice J. Drell said that N. M. D., a white woman aged 26 years, had had glasses prescribed for a mild refractive error in October, 1942. No ocular pathologic change was noted. In August, 1943, she returned with a history of blurring of the vision of the left eye of 3 days' duration. The corrected vision was R.E. 20/13; L.E. 20/30, slowly. The right eye was normal. The left eye showed a C-shaped raised area of choroiditis, deep to the retinal vessels, buttery in appear-

ance, and mottled with pigment disturbance, apparently made up of a number of smaller confluent foci, and enclosing the macula in the concavity of the C. Campimetry showed an absolute paramacular defect almost exactly duplicating the lesion. During the ensuing two weeks the lesion extended to include the macula. The vision of the left eye decreased to 20/200. During the following two months the lesion extended in spite of all therapy until it reached a size of 6 to 8 papilla-diameter radius about the disc. Many fine vitreous floaters appeared, and biomicroscopy showed innumerable fine pigment keratitic precipitates and a plus aqueous ray.

Extensive physical and laboratory examinations showed nothing of significance. Treatment consisted of atropine, nitrites (both orally and parenterally), proteolac, and a course of sulfathiazole. Finally the patient was hospitalized and given sulfadiazine and typhoid vaccine, with a rise in temperature to over 104°F. on three occasions. After the second of these, she showed subjective improvement and the vision improved to 20/70. Since then the vitreous has cleared, the pigment keratitic precipitates have practically disappeared, and the fundus lesion appeared to be inactive. The vision was 20/200. The rabbit-skin protection test for toxoplasmosis was reported at about the time of the typhoid injections.

The only history of contact is that chickens were kept in the yard of her downstairs neighbors. These had "colds" last summer, with sore eyes, and "tended to bury themselves in the ground."

Ocular toxoplasmosis

Dr. Maurice J. Drell said that D.N.C., a white man, aged 25 years, was seen in December, 1943, with a history of intermittent loss and return of vision. During the attacks the patient saw moving brown spots before the eyes. There had been no other symptoms. He stated that a number of years ago he raised rabbits as a hobby.

Corrected vision was R.E. 20/50; L.E. 20/200. Many vitreous floaters were present. The fundi showed many heaped hyperpigmented and atrophic chorioretinitic patches (0.25 to 2 papilla-diameters in size) throughout the fundi, with involvement of both macular areas. There were also several bands of proliferating retinitis. Biomicroscopy showed a rare cell in the left anterior chamber. All laboratory and X-ray examinations were negative. The rabbit-skin protection test for toxoplasmosis was reported strongly positive.

Ocular toxoplasmosis

Dr. Maurice J. Drell said that B. B. S., a white woman aged 25 years, gave a history of poor vision in the right eye of 7 days' duration. On examination, the vision R.E. was perception of hand movements at 1 foot. There was a ciliary flush. Keratitic precipitates were grossly visible. The pupil of the right eye was irregular and larger than that of the left eye, and reacted slowly. The fundus showed a marked vitreous haze, through which could be seen a raised area of yellow-white exudative choroiditis surrounding the disc and extending past the macula. There were several small hemorrhages at its edges. Biomicroscopy showed many keratitic precipitates and many cells, and 2-plus aqueous ray, as well as posterior synechiae at the 2- and the 6-o'clock positions. On the Bjerrum screen an absolute right central scotoma of 10 to 20 degrees was elicited, extending outward to include an almost complete inferonasal-quadrant anopsia.

The synechiae were severed with sub-

conjunctival epinephrine. Local instillations of atrophine were given, and brewer's yeast was administered by mouth. Extensive etiologic investigations showed nothing of significance. There was a daily rise of temperature to 99°F. The red blood cell count fell from 4.78 on November 3d to 3.92 on November 29th. At that time, the toxoplasmosis rabbit-skin protection test was reported as strongly positive. Injection of the patient's blood into a mouse gave no results.

The eye continued to improve slowly; the anterior-chamber reaction was minimal, and the fundus showed a large white atrophic peripapillary chorioretinitic lesion with hyperpigmented margins. The only relevant feature in the search for a contact was that someone in the family had raised chickens, a number of which had died quickly during the summer.

Afferent Sturge-Weber-Osler-Dimitri syndrome

Dr. Maurice J. Drell presented G. C., a white man, aged 41 years, who had been seen intermittently for 10 years. A tentative diagnosis of migraine had been made by the neurologic service in 1939. In November, 1940, he reported a history of blurring of the vision of the right eye for 5 days. The fundus of the right eye showed several hemorrhages in the depth of the physiologic cup, and numerous tiny hemorrhages scattered throughout the fundus. The veins were tortuous, moderately dilated, with compression at the arteriovenous crossings. The arteries showed slight uniform increase in the central light streak, but no definite attenuation. The fundus of the left eye was normal. Campimetry of the right eye revealed a paracentral scotoma. The visual haze of the right eye varied in intensity for a few weeks and finally disappeared. The hemorrhages were absorbed over a period of six weeks. General physical examination, complete hematologic study, and X-ray films revealed nothing significant.

The patient returned in December with a history of recurrence of blurring in the visual field of the right eye. The vision was 20/13 in each eye. The fundus of the right eye showed tortuous dilated veins and attenuated arteries. In the macular region was fine new-vessel formation with a tiny hemorrhage just beyond the terminal twigs of two of these vessels. Campimetry showed a relative sector-shaped paramacular scotoma lying between the fixation point and the blind spot. The tension had always been normal. All laboratory studies were non-revealing. A port-wine type of nevus was noted on the lower lip. The blurring was present intermittently for 10 days, then the vision diminished to 20/200, a few more hemorrhages were found, and a dense centrocecal scotoma was present. Three days later the fundus had the appearance of a partial central-vein thrombosis with perhaps complete occlusion of the superior temporal branch, showing papilledema, exudates and sheetlike hemorrhages in the region of the distribution of the superior temporal vein, and smaller hemorrhages throughout the fundus.

Since then the disc had become flat, hemorrhages and exudates had been absorbed, the vision slowly improved to 20/16, and the scotoma thinned out. Therapy consisted of nitrites, potassium iodide, vitamin-B complex, and citrus juices. Following the development of the picture of vein occlusion, atropine was given on three different occasions as a retrobulbar injection.

It is possible that the clinical picture fits into the phakomatosis group, postulating the presence of an angioma of the ophthalmic vessels, with each recurrence

representing the result of an embolic phenomenon.

Scientific program

Corneal dystrophies

Dr. Robert Von der Heydt presented a paper on this subject which was published in this Journal (1945, v. 28, Jan., p. 55).

Discussion. Dr. Robert J. Masters said that corneal dystrophies have a tendency to follow patterns of development that fail to be typical. Even in familial hereditary granular type they may exhibit a varied appearance in the eyes of the same individual or in members of the same family.

In 1940, A. Pillat, in an article in the Klinische Monatsblätter für Augenheilkunde, described a familial corneal dystrophy characterized by peculiar central flaky and peripheral lattice-shaped opacities in both eyes of the same individual. The central changes were described as peculiar crumblike opacities deeply situated in the stroma, not in the shallow portion under Bowman's membrane. This patient's sister had the same condition, and there was a history of eye disturbance in the father and grandfather. One might believe that Pillat's patients had mixed in the two eyes two types of dystrophy, granular and lattice-shaped, according to the classification of Bücklers. Pillat felt sure that his patients exhibited a new type of dystrophy.

The term dystrophy means defective nourishment and can be applied to many types of nutritional disturbance of the cornea, of senile, inflammatory, or occupational irritative origin, or of the hereditary type with which the term is usually associated. Davidson suggested that corneal dystrophies be classified as senile, secondary, occupational, and hereditary. In the senile type he would put arcus senilis; in the occupational type, long-continued irritation due to chemicals. Regarding Fuchs's epithelial dystrophy, it is difficult to explain why so many elderly people have so few epithelial dystrophies, unless there is some hereditary tissue tendency that predisposes the cornea to development of the changes which typify Fuchs's epithelial dystrophy.

There is no question but that the most profitable study so far as dystrophies are concerned comes from repeated examination. Dystrophies are bilateral; those of hereditary type are inclined to progress; they are avascular. Certainly it is important before undertaking a cataract operation to make a thorough examination with the slitlamp to ascertain the condition of all the ocular tissues including the cornea. This leads to the question as to the experience of others who have operated for cataract upon eyes which exhibited a corneal dystrophy. How did the eye heal and what, if any, complications developed?

Dr. Sanford Gifford recalled a patient with very marked dystrophy on whom an intracapsular extraction was performed. Following operation she developed what looked like Fuchs's epithelial dystrophy. This does not develop until the guttata lesions are so advanced that the aqueous gets into the cornea. The operation apparently put the finishing touch toward development of the condition.

Dr. Vernon M. Leech stated that Dr. Masters mentioned the importance of careful slitlamp examination prior to operation for cataract. Faint corneal opacities, especially early dystrophies, stand out fairly well with oblique illumination when the pupil is large and black, but are difficult to see when the background is gray from cataract formation. He recalled the case of a woman who had had cataracts diagnosed, and before she would permit examination except for a glance

at her eyes with oblique illumination, she insisted on a general discussion of cataract surgery. She was assured that there was nothing to worry about; that the results were preponderantly good, vision could be restored, and so forth. When examination was completed, including slitlamp study, a bilateral central dystrophy was found, which caused modification of the prognosis on her cataract operation.

Dr. Peter Kronfeld said that the incident reported by Dr. Gifford had been observed in at least three cases at the Illinois Eye and Ear Infirmary. In two cases the picture was that of marked cornea guttata; in the third beginning epithelial changes were superimposed upon the cornea guttata.

In a case of that type observed by Dr. Terry of Boston, and reported before the New York Society for Clinical Ophthalmology, he also raised the question of what to do with the other eye. If he performed a cataract extraction he would fear that the second eye would take the same unfortunate course as the first.

Dr. Robert von der Heydt, in closing, replied to Dr. Masters, in reference to Pillat's case, if Bückler's classification is accepted, each of his three types presents a definite clinical entity. No one type resembles another if carefully differentiated. In the picture shown of the incipience, there were lesions under Bowman's membrane and within the stroma. The crumb-like pattern is seen throughout the stroma and at all depths. In Pillat's case the central area may have been somewhat similar. However, there were no lattice lesions. The lines were radical and only at the limbus.

With regard to cornea guttata, there are many senile and presenile persons having disseminated guttata spots in the corneal center. There must be many hundreds before the endothelium is involved. This layer is the barrier membrane between aqueous and corneal stroma. The guttata lesions must be extremely numerous to cause an epithelial dystrophy.

The postoperative condition which may develop and which resembles Fuchs's epithelial dystrophy is due to accidental trauma to the endothelium by instruments. We find a similar condition in birth injuries; there is a milkiness of the whole cornea such as seen in the early stages of interstitial keratitis. It is not due to the fact that Descemet's membrane has ruptured, but to the splitting of the endothelial layer. When it re-forms the barrier function returns and the corneal stroma clears.

Robert Von der Heydt.

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DIRECTIVES FOR ETHICAL DISPENSING

In the February issue of this Journal the writer discussed the ethics of dispensing lenses. The editorial created some comment, hence he thought that further consideration of the subject might be profitable. He suggested that the Section on Ophthalmology of the American Medical Association define acceptable methods and he touched briefly on some of the practices now employed. It is perhaps worthwhile to enlarge somewhat upon different possibilities for dispensing glasses. But before doing so, it might be well to generalize a little. In the first place, there should be no idea in the minds of anyone that the question is primarily one of integrity. It must be obvious that if an ophthalmologist desires to capitalize unscrupulously on his patient, he can do this in many ways other than by taking a profit on glasses. For example, he may be entirely ethical in his dispensing of glasses and still have patients make unnecessary visits to his office, or he can perform operations that are not needed. There isn't anything against the law in an eye physician's taking a major part of the profit from the sale of optical goods, though he might need a retailer's license to do so. The question is whether this practice is regarded by physicians as fulfilling the best ideals of the profession.

A second point is that a sufficiently broad concept is necessary to allow for the differences of practice in different localities, chiefly as concerns urban and rural areas. This may have for its crux rather the education of the public than of the doctor. Urban peoples have in general learned that the doctor's fee is largely for his opinion and advice, but in rural communities there is still a strong tendency for patients to think that they are paying for the medicine that they receive and not for the advice that they get. Likewise in small communities patients are far less willing to pay even a small fee for a refraction and a small amount for the glasses than to pay a bigger fee for glasses than for the other two combined. The necessity for the doctor to give something concrete in return for the patient's fee was so imbedded in the public mind that 30 years ago, even in large cities, some ophthalmologists made no charge if a new prescription was not given after the refraction!

The simplest method for the ophthalmologist is the one approved in the resolution passed by the Section on Ophthalmology of the American Medical Association in 1924, which indirectly endorses this method by stating that "we deprecate the selling of glasses by the ophthalmologist to his patients in communities where the services of reliable dispensing opticians are obtainable," namely that of referring his patients to a reliable dispensing optician. This method is surely above reproach if, by reliable we mean a nonrebating optician. The doctor makes a charge to the patient for his services to him and has no part in the financial transaction with regard to the glasses, though most opticians are glad to accommodate by charging less than the customary retail price to indigent patients on the doctor's request and by making any necessary changes in the prescription for the doctor within a reasonable length of time. If the optician, as is sometimes the case, is willing to sell lenses on a doctor's prescription for less than the customary retail price, this also surely cannot be objected to since it reduces the cost to the patients and is a logical procedure, because the optician is relieved of the expense incident to his performing the refraction, if he be licensed to do so, or of employing someone to give this service. This method with the above modification should be endorsed by the Section.

Where such opticians are not available, the ophthalmologist should be permitted to dispense his own lenses and make a charge to the patient that would include his physician's fee plus a charge for the glasses sufficient to cover his overhead in dispensing them. This would seem to be as open a method as can be employed where there is no dispensing optician available, since it is quite possible to let the patient understand the elements in the charge so that there need be no hidden fee. Undoubtedly this method permits of as liberal an interpretation of overhead as the ophthalmologist sees fit, but here the assumption is that the physician is actuated by a desire to deal honestly with his patient and his obvious limit is the cost of similar glasses in his community. This method should be accepted as ethical.

A third possibility for those who do not care to undertake the necessary labor of fitting and adjusting glasses and of performing the other mechanical essentials in the dispensing of glasses is the employment of a technician to perform these functions and making a charge for the glasses sufficient to cover the additional outlay of the salary of this individual. This is essentially the same as number two and should be acceptable.

A fourth method is the employment of an agency which performs the functions

of dispensing for the physician, the entire financial transaction being handled by the physician who makes the charge to the patient for both his fee and for the glasses and pays the bill for the optical goods and services to the agent. If the ophthalmologist will reveal the expense elements in the transaction to the patient, there should be no objection to this practice.

A fifth method is that which has been discussed under "Agency dispensing" in a previous issue of this Journal. In this case the agency collects the fee for the cost of the glasses, which within certain limits is specified by the doctor, and returns any surplus to the doctor at the end of the month or charges his account with any deficit. The writer believes that this almost surely entails a hidden fee and that the ophthalmologist cannot exercise adequate control over the cost of the glasses to the patient, or, broadly speaking, over the entire transaction and he thinks that this method should not be approved.

A sixth manner of handling glasses is through a company owned and controlled by one or more ophthalmologists, perhaps as a stockholders' corporation. There are several such concerns under the control of well-known and respected ophthalmologists. By them they are undoubtedly conducted ethically and without profit to the doctor from the business of handling merchandise. In such circumstances the cost of glasses to the patient can probably be reduced materially and excellent service given. The possibilities of entering into a business for profit in this arrangement is certainly ever present and its acceptance as an approved procedure should be contingent upon the willingness of those engaged in the project to permit of scrutiny of the business by whatever body is responsible for the medical ethics of the community.

Finally, the practice of referring a patient to an optician who returns a percentage to the ophthalmologist merely for referring the patient to him needs no comment.

The writer again urges that the Section of the American Medical Association study the matter anew and present some positive directives on the subject of the dispensing of lenses.

Lawrence T. Post.

PROFESSIONAL CLAIMS BY BRITISH OPTICIANS

The controversy as to who should have legal right to test and prescribe for refractive errors is likely to live a long life. There are some ophthalmic physicians who would prohibit entirely the prescription of correcting lenses by refracting opticians; and, on the other hand, there are "optometrists" who would permit medical practitioners to undertake refraction only after passing a special examination to show their proficiency in the subject.

It may be remarked that the use, in the preceding paragraph, of quotation marks around the word "optometrists" is justified by the fact that, according to the meaning of the French word from which the title was borrowed, anyone who measures the refraction of the human eye is an optometrist, whether his right to do so rests upon medical or a nonmedical basis. The word is not employed by British opticians, and does not appear to prevail in any of the British dominions or colonies outside of Canada and Newfoundland, which have of course been influenced by contiguity to the United States. "Refracting optician" would be much more accurately descriptive and much more intelligible to the general public, although perhaps less in

harmony with the ultimate professional ambitions of those who coined the word "optometry." In Great Britain the expression "optical practitioner" seems at present to lead the field, although it might of course be used just as well by the grinder of lenses or by what is known in this country as the "prescription optician."

The recent tentative scheme of the British Government (not yet passed into law) for a complete nationalized health service led to the creation by British opticians of a special committee, called "The Beveridge Report (ad hoc) Committee (Optical Profession)," which in due course published a carefully reasoned report on the controversial issues involved as between the medical profession and the optician. This report, although now over a year old, is not perhaps familiar to most American ophthalmologists, and a summary of its arguments may possess value for many of our readers.

Parenthetically, as regards the optical problem, it is well to remember the effect of constitutional differences between Great Britain and the United States. In the United States, legislative experiment is favored by the existence of an independent legislature for each state; whereas in Great Britain the privileges of local self-government are from time to time delegated by the national government to local bodies such as the county councils and municipal authorities. Thus the decision whether to give official recognition to "optical practitioners" has rested in the hands of the central government.

Attempts made by the optical practitioners, in 1906 and 1927, to introduce a system of state registration were defeated, partly because the British Parliament showed little inclination to concern itself with the proposal, and partly because of very strong opposition by the medical profession. The parliamentary bill introduced for the opticians in 1927 was studied by a "Departmental Committee," which we are told based its recommendation against the bill upon "the medical profession's promise that an efficient and comprehensive ophthalmic service would be available within a reasonable time."

British opticians have a sort of semi-official recognition in the fact that they have coöperated in the establishment of a register of optical practitioners whose work is accepted under the National Health Insurance administration. But the medical organizations of Great Britain have declined to participate in this arrangement, which is handled by a body called the "Ophthalmic Benefit Approved Committee," and in which the old mutual insurance organizations play an important part.

Five organizations, the British Optical Association, the Worshipful Company of Spectacle Makers, the Institute of Chemists-Opticians, the National Association of Opticians, and the Scottish Association of Opticians, conduct periodical examinations and issue diplomas as to proficiency in optical practice. These diplomas conform to a standard specified by the "Ophthalmic Benefit Approved Committee." The examinations cover theoretical and practical optics, subjective and objective methods of measuring refractive errors, optical apparatus including the testing of visual fields, anatomy and physiology, orthoptics, such knowledge of abnormal and pathologic conditions of the eye as is necessary for referring the patient to a physician, and lens grinding and fitting. In certain parts of the British Empire such an optical diploma "entitles the holder to admission to the state registry," although he has no such privilege in Great Britain.

The examination papers of one of the optical organizations, The Institute of Chemists-Opticians, are set, we are told,

under the supervision of the officials of the University of London. The optical Beveridge Report Committee quotes two ophthalmic surgeons, themselves examiners, as speaking highly of the standards of the examinations conducted for several of the optical organizations.

Opinions quoted from one of these ophthalmic surgeons (Tibbles), as given in the report, were expressed by him seven years ago in a letter to the British Medical Journal. This letter contained other statements of interest to students of the British situation. Tibbles asked, for example: "What is to become of the eye surgeons in the future, as they cannot possibly live on the small percentage of cases of diseased eyes, and at present the national health insurance patients, who form a big proportion of the population and formerly paid us fees themselves, are now sent to the optician, who can refer them to us if he thinks fit?" The other ophthalmic surgeon quoted is Lindsay Johnson, and it appears that his opinions were expressed eleven years before issuance of the report. In the interval, says the report, "All the optical examinations have been made of equal standard, and the standard has been appreciably raised."

The British optical societies, through their periodical examinations, are evidently making a sincere attempt to raise the standard of the refracting optician. If the sweeping governmental plan for socialized medicine is enacted into law, it seems possible that the services of British refracting opticians will be enlisted upon the basis of an important degree of professional recognition, in spite of the contention of many British ophthalmic surgeons that the optical practitioner should be utilized only under direct medical supervision.

The report of the "ad hoc" Committee of the British Opticians urges, as has been so often urged, and as is argued by the optometrists of the United States, that the numerical strength of ophthalmic surgeons is entirely inadequate to provide for the needs of the general public. The "ad hoc" report quotes the records of the British Medical Association as showing that there are only "1,000 ophthalmic surgeons and ophthalmic medical practitioners to deal with the requirements of 45,000,000 people, including surgical and pathological work." The number of British optical practitioners is given as in the neighborhood of 7,000.

The report of the Committee devotes a good deal of space to the history of refraction, with a view to showing "that ophthalmic optics has developed as a distinct and individual field of work." Arguments along these lines, which have been indulged in by both the medical and the optical protagonists in the general controversy, are beside the mark and are certainly not of vital significance. In the days in which physicians advised their patients to choose lenses in any optician's shop, it is quite certain that the said opticians did nothing more scientific than to grind or sell lenses. On the other hand, the outstanding pioneer in the refractive development of the past 85 years was a Dutch physician, F. C. Donders, who conducted his exhaustive investigations within the eye department of a university medical clinic.

The vital question now is how best to serve the public interest. The ultimate effect of the controversy between optician and physician, so far as controversy really exists, is likely to be a steady improvement of the standards of refraction work performed by both groups. Optometry propaganda in the United States has been an added stimulus in the movement for better standards among ophthalmic surgeons. In this country, in spite of the fact that there is much room for improvement, the standard of refraction work among ophthalmic surgeons is far ahead

of the standard among refracting opticians or optometrists, although a few states have done much to elevate the level of optometric practice within their borders.

There is some logic in the argument that physicians should not refract without a certificate of proficiency in this activity. But there is a very much greater need for restricting the optometric license, throughout the country, to those whose general and professional standards of education make it safe to entrust them with such responsibilities. It is rather probable that the centralized British system will show more rapid improvement, and greater justification for public confidence in the certified refracting optician, than the activities of optometric boards of examiners throughout the United States.

Another weakness of the report issued in behalf of the British opticians lies in its emphasis upon the fact that much of the time of the ophthalmic surgeon is devoted to general surgical and medical care of his patients, as distinct from the measurement of refraction. The report appears to overlook entirely the other fact that the optician is usually a merchant who devotes a great proportion of his time to purely commercial and mechanical phases of his business.

Sooner or later the general public will act as umpire in the tug-of-war between ophthalmologist and refracting optician, as it did a hundred years or so ago in the battle for the establishment of a dental profession divorced from the practice of medicine so far as licensure was concerned. Apart from questions of science and philanthropy, the two professional groups have an economic stake in the outcome; and the public, ignorantly or wisely, will in turn also decide upon the basis of self-interest.

Cost of service will receive due consideration, but, in the end, quality of service will be the deciding factor. Improvement in professional standards, in either camp, will not in the long run lower but raise the cost of service so far as individual refractive prescriptions are concerned, and yet may ultimately lower the cost of service by reducing the frequency with which customers or patients are reëxamined or pass from one examiner to another. Those who fear the results of competition should recognize that improvement in any line of service to the public usually broadens recognition of need and therefore increases demand for such service. Economic pressure may force a considerable section of the public to seek for a while the apparently cheaper type of service; but, on the average, those who are able to pay for better and more expensive service will usually be willing or eager to do so. W. H. Crisp.

REHABILITATION OF THE WAR-BLINDED

American war-blinded soldiers in World War II will not return to their homes without having had the benefit of the best possible training in matters connected with their adjustment to civilian life and their future as civilians. Under the direction of The Surgeon General of the United States Army, a program has been set up at Old Farms Convalescent Hospital (Sp), Avon, Connecticut, which will return the blinded service man to his community, with a knowledge of his own abilities and with a desire to resume his normal place in his own community life.

New methods of training the blind are being developed at Old Farms—methods which are designed to fit the individual trainee, and designed *for* the veteran—using as a basic principle the necessity of seeing to it that the blinded veteran regains completely his own self-confidence. The program aims at showing the man

that, though blinded, he need make very little change in his plans for the future.

The soldiers blinded in this war are for the most part young men and, as young men, they of course have all of the ambitions, dreams, and plans that American young men have. Their blindness has come to them with a terrible suddenness. There has been no time for them to sit down to think or plan prior to its arrival. The result is that when the soldier is told that he is blind, he at first sees toppling about him all of his future and feels that he is doomed to a life of dependency and helplessness. The Old Farms program in conjunction with programs at Valley Forge and Dibble General Hospitals, which treat the men surgically and medically, has done much to remove this feeling and the soldier goes back to his civilian life with an ambition to get to work and to carry on with his business of living.

Old Farms is under the command of Col. Frederic H. Thorne (MC), one of the Army's outstanding ophthalmologists, and is staffed by Army officers, enlisted personnel, and civilian instructors who are trained not only to work with the blind, but to work with blinded soldiers. The program covers a period of 18 weeks, which is felt to be the minimum time in which the best possible job can be done in social adjustment and the maximum time it is possible to hold most of these men in such a program without taking the risk of institutionalizing them in their outlook. All Army blinded will go to Old Farms prior to discharge. The program is four-fold. In the first place it involves general orientation, and in this orientation emphasis is placed on adapting methods to the man, not the man to preconceived methods. One of the basic things done is to train these soldiers to go about the grounds of the Hospital without canes and without aids of any kind. In the accomplishment of this purpose lies a great deal of the self-confidence which Old Farms wants to put into the men. They learn that, in familiar surroundings, they can go where they want to go, when they want to go, and as they want to go, without depending on any one with sight. The result is that many visitors to Old Farms have been startled to find they have been talking to men whom they have met on the grounds who were blind and who they had no idea were blinded. The second part of the training involves attendance at classes. A wide variety of classes, which includes virtually anything that any man might want to know more about, is available. Work with power machinery such as drill presses, lathes, and other machines, agricultural work, industrial-therapy work in which the hobby angle is stressed, music, Braille, and dozens of others make up the approximately 45 courses. The man is encouraged to take as many of them as he will and can, and to develop new interests if former ones seem inadequate to his new status. Throughout, however, while the man has advice and guidance, his final decision as to his future is his own. An important factor of the courses has been a practical phase in which men are sent into Hartford factories and war plants doing the work of sighted men, beside and in competition with sighted men, and making a record in the doing which has considerably startled local industrialists. Their production record is high and their accident record is zero. The third phase of the work covers the all-important—to the American boy—problem of athletics. Gone are the days of setting-up exercises and long walks. Instead, these war veterans find they can, with almost no exception, take part in and enjoy the sports which they enjoyed before they became blinded. A well-rounded athletic program includes

horseback riding, golf, bowling, roller skating, ice skating, winter sports, swimming, gymnasium work, wrestling, boxing, fishing, and many other activities, and the men soon find that they can still enjoy what they did.

The final division of the program is that of recreation, and under the direction of competent Red Cross Field Representatives an extensive recreational program is provided. The men go to dances, concerts, dinner parties, plays, movies, sports events, and they play cards, checkers, and all the many games they knew before. Here again the man finds that his blindness does not mean that he will spend his life as a drag on any party he may attend. He finds that here again normalcy is possible.

When the man finishes his 18 weeks at Avon he is given a certificate which certifies his readiness to return to civilian life, having fulfilled the standards of social adjustment set up for him by the Army. He returns with a confidence in his own ability to make a success of his life and he returns with a desire to do something more than exist in endless days to come on a pension. However, the real job will be done by the public, for these men returning to their homes in full knowledge of their potential abilities will expect and will deserve the chance to use them, and if communities will accept them as normal and take them into their normal community life and avoid the silly and, to the men, objectional displays of pity and sympathy so common with the blind, these blinded men will make a success of their lives and will make citizens of whom their communities may well be proud. However, the answer will lie, not with the Army, not with the man, but with his community.

When he leaves Avon he leaves with the basic training necessary, and he becomes the active interest of the Veterans Administration. It is the job of the Veterans Administration to see that the man receives any additional or specialized training he may want; that his rights under the GI Bill of Rights are protected; that he is given assistance in locating a suitable job, and that he is given the aid and counsel which will mean the proper start. Once he leaves Avon, he is a discharged soldier and the Army loses the right to aid him further, but the men at Old Farms have found that the interest of the Army does not end with his discharge, and there is rapidly growing up something which resembles closely the alumni spirit to be found in schools and colleges of this country.

The Army, the blinded soldier, the Veterans Administration, and the public make up a team which, together, can end for all time dependency and helplessness for these men.

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Public Relations Officer.

BOOK NOTICE

STUDIES OF CIRCULATORY DISTURBANCES, PULSE WAVE VELOCITY AND PRESSURE PULSES IN LARGER ARTERIES IN CASES OF PSEUDOXANTHOMA ELASTICUM AND ANGIOID STREAKS., By Uno Carlborg. Acta Medica Scandinavica, Supp. CLI. Paper covers, 209 pages with 19 illustrations. Uppsala, Appelbergs Boktryckeri A.-B. 1944.

As the title suggests, this monograph is not primarily an ophthalmologic treatise. This excellent piece of clinical investigation does, however, have ophthalmologic interest, just as it has interest for the dermatologist, internist, and vascular physiologist. The author seems to

have integrated well the contributions of each of these fields in the present study. The first of the two parts of the paper is devoted to the clinical aspects of the problem. There is an extensive historical review which includes most of the 130 known cases of associated pseudoxanthoma elasticum and angioid streaks. The author uses the name "Grönblad-Strandberg's syndrome" for the ophthalmologist and dermatologist, respectively, who elucidated this association. He presents a careful picture of the skin and eye findings. In both organs, the pathologic processes consist in degenerative changes in elastic connective tissue.

Fifteen typical patients are presented, in detail, and the author was able to demonstrate that symptoms of peripheral circulatory insufficiency were common. Pathologically, the vessels of the extremities, the abdominal viscera, the eye, and the skin showed elastic-tissue degeneration. Cardiac and aortic findings, on the other hand, were not marked, and the author points out that in these structures elastic tissue is relatively sparse.

The etiology of the disease is unknown, except for the facts that it is a dystrophy of the elastic tissue throughout the body, and that it is hereditary, being transmitted as a recessive. Blood chemistry, metabolic, and other laboratory studies show no characteristic abnormalities, nor are the circulatory symptoms pathognomonic. Hemodynamic studies undertaken by the author did, however, show characteristic features. The second part of the monograph deals with these observations. Carlborg was able to demonstrate decreased pulse-wave velocity. Sphygmograms showed characteristic abnormalities, and oscillometric studies showed abnormally low curves. Comparisons with normal individuals and with senile arteriosclerotics revealed the changes to be, on the whole, peculiar to the group of patients under investigation. The author holds that the same explanations advanced for the altered physiology of the circulation in arteriosclerotics cannot be applied to these patients, since they are too young in most instances, and since the author was unable to find any reasons to suppose that there was actual narrowing of the caliber of the vessels. He concludes that the altered hemodynamics in patients with the Grönblad-Strandberg syndrome are the result of the elastic degeneration in the muscular vessels. This atrophy permits the damping, "shock-absorber" effect of the vessel musculature (hysteresis) to play a dominant role in pulse-wave transmission, and explains to a great extent the decrease in pulse-wave velocity and the other abnormal circulatory findings.

The author feels that this study contributes in a measure to the knowledge of the physiology of the circulation, since this disease enables one to study the manner in which the vessels function, *in vivo*, in the absence of the elastic component. He feels that too little emphasis has been placed, hitherto, on the role of smooth-muscle hysteresis.

The monograph represents clinical investigation on its highest plane, characterized by painstaking care in each detail. It may well be considered a model for good clinical research, and should constitute interesting reading for a student of any of the medical specialties from which the author has drawn his material.

Benjamin Milder,
1st Lt. (MC), A.U.S.

ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

6

CORNEA AND SCLERA

Friedenwald, J. S., and Buschke, W. **Mitotic and wound-healing activities of the corneal epithelium.** Arch. of Ophth., 1944, v. 32, Nov., pp. 410-413; also Trans. Amer. Ophth. Soc., 1944, v. 42.

This investigation was undertaken in an effort to discover the physiologic controls and biochemical aspects of mitotic and wound-healing activities. The method of assay of mitosis depends upon routine counts of a meridional strip of rat cornea. In normal young adult rats there are approximately 5,000 to 6,000 mitoses per cornea, or 100 mitoses per strip counted. Normal variations range from 50 to 200 mitoses per strip. However, mitotic activity cannot be gauged solely by the number of mitoses present at a single moment, since that number is affected both by the rate at which cells enter mitosis and by the rate at which cells pass through the mitotic cycle.

Other investigators have shown in other organs that colchicine arrests the mitotic cycle in metaphase but does not influence the rate at which cells enter mitosis. Hence, the number of cells observed in mitosis at a fixed time after administration of colchicine furnishes a measure of the rate at which the cells enter mitosis. By a combination of methods it was found that the duration of mitosis in the normal cornea was about seventy minutes and the intermitotic interval for the basal cells approximately one week. Under suitable conditions the mitotic rate could be maintained almost at the normal level in the enucleated eye kept in a moist chamber in the incubator.

Histamine, acetylcholine, physostigmine, pilocarpine, carbaminoylcholine chloride, and atropine were found to be without effect on the mitotic activity. Epinephrine, on the other hand, produced a notable inhibition of the entrance of cells into mitosis, without disturbing the development of the mitosis once it had begun. By intramuscular injection of epinephrine in peanut oil, mitosis in the cornea could be suppressed for many hours. Ephedrine had a similar effect.

The number of cells observed in mitosis after superior cervical sympathetic ganglionectomy was normal in simple counts but was greatly reduced after administration of colchicine. Cocaine, ether, and barbiturates produced notable inhibition of the initiation of mitosis. Mechanical damage to less than 0.1 percent of the epithelial cells of the cornea caused inhibition of mitosis in the remaining, apparently uninjured, cells for several hours.

Ultraviolet light and radiation with beta rays of radium also inhibited the onset of mitosis. Decrease in temperature to 30° C. did not make it impossible for cells already in mitosis to complete their division. Deficiency in vitamin A decreased the rate of mitosis and, to a somewhat lesser degree, the progress through the mitotic cycle. Up to the present the authors have encountered no agent which produces an increase in the rate of mitosis though with many substances there is an overshooting of the normal rate of mitosis for a brief period after recovery from inhibition.

The second part of the paper deals with wound healing. In order to separate the primary phenomenon of wound-healing from the inflammatory reaction and secondary infection of large wounds, the authors chose for study minute epithelial defects produced by needle pricks of the corneal surface. One hour later there was no visible change. Two hours after the injury the basal marginal cells had changed their orientation and lay with their long axes radial to the hole. Three hours after the injury the majority of the holes were covered. After the initial period of lag of one hour, the rate of cell movement in closing these small holes was 0.25 microns per minute. The wound-healing phenomenon proceeded equally well in enucleated eyes kept either in a moist chamber or in aerated solutions in the incubator.

Wound-healing in the corneal epithelium occurred at a p_H of from 4.5 to 9.5. The process was much less sensitive to pharmacologic interference than was mitosis. Local anesthetics such as cocaine and tetracaine inhibited the process, but of the general anesthetics administered systemically only morphine had a measurable effect. Ultraviolet radiation did not inhibit wound healing except in doses producing sloughing of the epithelium. Anoxia, sodium cyanide, and sodium azide inhibited the healing process. Tables are given which report on many other changes than those mentioned. (References.) R. W. Danielson.

Mann, Ida. **Ariboflavinosis.** Amer. Jour. Ophth., 1945, v. 28, March, pp. 243-247. (3 color plates, references.)

Pannabecker, C. L. **Keratitis neuroparalytica. Corneal lesions following operations for trigeminal neuralgia.** Arch. of Ophth., 1944, v. 32, Dec., pp. 456-461; also Trans. Sec. on Ophth., Amer. Med. Assoc., 1944, 94th mtg.

This is an analysis of the corneal lesions complicating 878 operations for trigeminal neuralgia. Corneal anesthesia and lagophthalmos are the important factors in the production of corneal lesions. Neuroparalytic keratitis may be classified as follows: (1) parenchymatous, with absence of ulceration; (2) superficial, a benign form, with areas of desquamation; (3) ulcerative, with a tendency to regression and moderate corneal damage; and (4) persistent. Exposure keratitis is a degenerative condition due to desiccation result-

ing from lagophthalmos. Lagophthalmos may develop as the result of surgical trauma of the facial nerve. Corneal anesthesia and lagophthalmos combined give the greatest incidence of corneal lesions (65 percent). Operations complicated by the presence of neoplasms are more likely to result in paralysis of the facial nerve and exposure keratitis. The patient with corneal anesthesia following operation for trigeminal neuralgia is most susceptible to development of neuroparalytic keratitis during the first few months after operation, but the disturbance may occur much later. Early tarsorrhaphy should be performed in doubtful or suspected cases and the lid be thus partially closed for six months. (4 tables, references.)

John C. Long.

7

UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Nuri Fehmi Ayberk. **Adie's syndrome.** Göz Klinigi, 1944, v. 1, no. 6, p. 227.

After quoting some literature the author gives the differential points between Adie's syndrome and the Argyll-Robertson pupil.

Joseph Igersheimer.

Pendse, G. S. **Allergy in tubercular affections of the eye.** Indian Jour. Ophth., 1944, v. 5, Oct., pp. 63-66.

A general discussion of ocular tuberculosis and tuberculin treatment is followed by report of two cases in which uveitis was thought to be due to tuberculous allergy and recovered after local and general treatment, the latter including injection of tuberculin.

W. H. Crisp.

Rahim, S. A. **A case of polycoria.** Indian Jour. Ophth., 1944, v. 5, Oct., p. 67.

A boy aged 12 years presented the conditions shown in illustrations of the two eyes. In the right eye, with very poor vision, only a small amount of iris was present, in the form of a K-shaped figure probably connected at several points with the ciliary body. The optic disc was deeply cupped, the cornea slightly larger than that of the left eye, and the tension 30 mm. (instrument not mentioned). The left eye, with vision of 6/24, showed a spindle-shaped pupil at the lower inner quadrant next to the limbus, a smaller irregular pupil at the lower outer quadrant, and five holes in the iris tissue which occupied a little more than the upper half of the pupillary area and was connected by a bridge with the ciliary body below. The fundus could not be properly seen, and the tension is given as 40 mm. W. H. Crisp.

Scobee, R. G. **Rubeosis iridis diabetica.** Texas State Jour. Med., 1944, v. 40, Dec., p. 432.

A case of rubeosis iridis diabetica is reported, with successful surgical result in the secondary glaucoma associated with the rubeosis. Cyclodiathermy was the procedure used. The possible etiology of rubeosis of the iris is discussed, and also possible reasons for the success of the cyclodiathermy.

Theodore M. Shapira.

Sverdlick, José. **Phenomena of secretory activities in the epithelium of the ciliary processes.** Reprint from Arch. de Histologia Normal y Patologica (Buenos Aires), 1944, v. 2, July, pp. 248-265.

The experimental material was de-

rived from man and from the dog and rabbit. It was possible to demonstrate in the cells corresponding to the superficial layer of the ciliary processes a granular substance, the character of which differs from the mitochondria and from the lipoid vesicles described by various authors, but possesses characteristics corresponding to secretory granules. By the location of the granules in the part of the cell bathed in aqueous humor, it is deduced that the cells are related to the process of formation of this fluid. (8 figures, references.) W. H. Crisp.

8

GLAUCOMA AND OCULAR TENSION

Gözcü, N. I. **Pathogenesis and treatment of the glaucoma syndrome, and results of peripheral iridectomy.** Göz Klinigi, 1944, v. 2, no. 1, p. 1.

The author believes like Magitot that glaucoma is mainly due to disturbance of the uveal circulation, the cause of which is a sympathicotonia in the eye. He thinks sympathetic ganglia in the eye are destroyed by peripheral iridectomy, with the result that the local sympathicotonia is cured. Three successful peripheral iridectomies in glaucoma are discussed.

Joseph Igersheimer.

Kronfeld, P. C. **Gonioscopic correlates of responsiveness to miotics.** Arch. of Ophth., 1944, v. 32, Dec., pp. 447-455; also Trans. Sec. on Ophth., Amer. Med. Assoc., 1944, 94th mtg.

Angle-block glaucoma, wide-angle glaucoma, glaucoma secondary to iridocyclitis, glaucoma after cataract operation, and glaucoma associated with capsular exfoliation are discussed in some detail, with particular reference to gonioscopic findings as correlated with responsiveness to miotics. In angle-block glaucoma it is probable that miotics favorably affect the glaucoma largely through their miotic action. Gonioscopic studies have shown that in this type the smallest sector of open angle that is compatible with normal intraocular pressure is 70 to 90 degrees of arc.

Glaucoma caused by peripheral anterior synechias resulting from delayed restoration of the anterior chamber after cataract operation is discussed. Three variations of the anterior edge of the adhesions are found; namely a solid, sharply demarcated line; a fuzzy, scalloped zone, and multiple thready, filamentous adhesions. The first type gives rise to the more serious cases of glaucoma. Most cases of glaucoma following cataract extraction respond in some degree to miotics. In eyes with senile capsular exfoliation, irrespective of whether or not glaucoma is present, the gonioscope shows particles of exfoliated capsular material deposited on both walls and in the vertex of the angle, in addition to pronounced pigment infiltration of the trabecula. In cases of so-called primary glaucoma not of the iris-block type and of glaucoma secondary to iridocyclitis, there is no apparent relation between the gonioscopic picture and the efficacy of miotics. John C. Long.

9

CRYSTALLINE LENS

Hughes, W. L., Guy, L. P., and Romaine, H. H. **Use of absorbable sutures in cataract surgery.** Arch. of Ophth., 1944, v. 32, Nov., pp. 362-367.

After trying the different kinds of absorbable and nonabsorbable sutures,

the authors come to the conclusion that absorbable suture material for use in cataract operations is more desirable than a material that must be removed, since complications incident to removal of the sutures are avoided. The nearest approach to the ideal suture, holding seven to ten days, colored for ease in identification, economical in price, easy to handle, and well tolerated by tissues is 00000 plain surgical gut. But this suture is less flexible than silk, and the authors do not feel that it fulfills all the requirements for an ideal suture. (3 figures.) R. W. Danielson.

Samuels, Bernard. **Complicated cataract associated with spontaneous detachment of the retina.** Arch. of Ophth., 1944, v. 32, Nov., pp. 416-422; also Trans. Amer. Ophth. Soc., 1944, v. 42.

In three recent papers the author has discussed and illustrated the pathologic changes in the lens in perforating ulcer of the cornea, in leucoma adherens, and in spontaneous iritis, respectively. The purpose of the present studies has been to ascertain the changes which may occur in a lens as a result of various pathologic conditions in the globe. The cataract that is associated with retinal detachment often has a peculiar yellowish-white hue.

The material consisted of microscopic preparations of lenses from 21 globes. There were 11 specimens which were associated with a history or anatomic signs of myopia. Only cases of spontaneous detachment were chosen, those being excluded in which the condition was caused by tumor, exudative retinitis, angiomatosis of the retina, or by retinitis interna and externa. A majority of the 21 globes were removed because of development of the well-known triad that may follow sooner or later in the wake of the detached retina; namely, iritis, secondary glaucoma, and cataract. A globe with an old detachment or one with a potential detachment is intolerant to ever so slight a blow.

In all probability, in many cases iritis should not be considered a complication of the retinal detachment but should rather be regarded as a sequel of a hidden inflammatory process that antedated the detachment and was in fact the original cause of it. Occasionally a detachment causes a complicated cataract without any sign of inflammation either clinical or pathologic in the anterior part of the globe. Causes other than the detachment that were believed to have contributed to development of the cataract were iritis, altered metabolism, and glaucoma.

The cause of inflammation of the iris associated with retinal detachment has never been clearly explained. However, that the iritis is produced by toxins in the stagnant subretinal fluid seems to be proved by the fact that after puncturing the sclera and allowing the fluid to escape, as advocated by Meller of Vienna, the iritis more often than not quiets down. A factor in altered metabolism considered to have exerted an unfavorable influence on the lens was interference with the outflow of intraocular fluid into the papilla. Then, too, a disturbance of the general metabolism of the body may set up inflammation in a diseased globe whereas it may have no effect on a sound eye.

The author discusses associated changes in the retina, subretinal fluid, choroid, vitreous, ciliary body, and iris. There was no evidence that the choroid was the source of the subretinal fluid, particularly since the pigment epi-

thelium was never raised. Specimens from 17 globes permitted examination of the vitreous anterior to the retina. In five cases the vitreous was detached and in five others it was traversed by membranes. In three cases it contained blood. A "step" in the retina at the point of a detachment of the vitreous is an anatomic sign of traction. This observation seems to substantiate the theory that most retinal detachments result from traction by bands of broken-down vitreous. The iris was often severely irritated, the ciliary body seldom. Clinically, iris bombé in a globe that is known to have been blind for a long time may well be regarded as a sign of retinal detachment.

Exhaustive microscopic studies of the lenses were made. When this series of lenses was compared with the three previous series as to the extent of the changes and their frequency and distribution, the following characteristics of cataract associated with spontaneous retinal detachment were apparent: (1) the presence of well-defined vesicular cells in the posterior quadrant of the lens: these cells were observed to occur in far greater abundance and frequency than in the other series; (2) the lining of the entire capsule by a single layer of epithelial cells in greater abundance than previously noted.

The author concludes that the presence of epithelial cells in the posterior quadrant of the lens, where normally there are no cells, implies that they had proliferated in that direction in response either to a chemical agent or to an inherent impulse to grow backward. (8 figures, references.)

R. W. Danielson.

Thomas, C. I. **Suction instrument for cataract extraction.** Amer. Jour. Ophth., 1945, v. 28, March, p. 317. (One figure.)

Verhoeff, F. H. **Removal of the ruptured capsule in operations for cataract.** Arch. of Ophth., 1944, v. 32, Nov., pp. 407-409; also Trans. Amer. Ophth. Soc., 1944, v. 42.

In the so-called intracapsular operation for cataract, the capsule sometimes ruptures. If the broken capsule recedes into the eye, the extraction usually becomes extracapsular. When rupture does occur, it is due to one or more of the following causes: (1) Imperfect technique: the incision is too small for the cataract, or, more often, the operator through impatience exerts too great traction with the forceps or too little pressure with the expressor. (2) The forceps is poorly adjusted and tends to bite a hole in the capsule. (3) The patient is a "bad actor," making a wide movement of the eye at a critical time.

There are two types of rupture of the capsule that are really fortunate occurrences, for each not only insures complete removal of the capsule but as concerns loss of vitreous makes the operation safer than when the cataract is removed without rupture of the capsule. In the first of these types, the capsule ruptures below and is completely removed by the forceps, the cataract being left within the eye. The nucleus should then be expressed with great care, and the sutures should be pulled up before the remaining lens material is irrigated out. In the second type, the capsule ruptures elsewhere but remains prolapsed in the wound after the nucleus has been expressed. Such a capsule can easily be picked up with forceps and completely removed.

The author has devised a simple pro-

cedure to apply to this situation. The procedure consists essentially in keeping the anterior chamber filled while the capsule is grasped and removed with the angular capsule forceps. After one suture has been tied the opening of the wound is so much reduced in size that the chamber can easily be kept sufficiently distended by gentle, continuous irrigation with isotonic solution of sodium chloride. For the irrigation a small metal tip attached to a rubber bulb is used. Occasionally the author has carried out the irrigation with his right hand while he removed the capsule with a forceps held in his left. He prefers, however, that a capable assistant carry out the irrigation so he can give his entire attention to removing the capsule. (References.) R. W. Danielson.

10

RETINA AND VITREOUS

Agatston, S. A. **Relation of blood dyscrasia to retinopathy.** Arch. of Ophth., 1944, v. 32, Nov., pp. 388-390.

All types of retinopathy are based on localized structural changes in the blood vessels and capillaries, irrespective of the cause. Since nutrition of the walls of small vessels and capillaries depends on the quality as well as the quantity of the blood within, qualitative or quantitative reduction results in degenerative changes.

The following blood dyscrasias may be responsible for ophthalmic manifestations: chlorosis, pernicious anemia and sprue, Jaksch anemia (anemia infantum pseudoleukemica), secondary anemia, sickle-cell anemia, aplastic anemia, hyperplastic anemia, erythremia (polycythemia vera), secondary polycythemia, purpura hemorrhagica, hemophilia, scurvy, lipemia, leukemia, sepsis, and diabetes. The author gives briefly the fundus picture of each of these diseases. (References.)

R. W. Danielson.

Ballantyne, A. J. **Observations on the pathology of thrombosis of the central vein of the retina.** Trans. Ophth. Soc. United Kingdom, 1943, v. 63, pp. 137-142.

The author presents the pathologic findings in the case of circinate retinopathy reported by Loewenstein and Garrow (see below). The central vein was traced with difficulty as it was obliterated by an organized thrombus or by sclerosis, but there were open venous channels situated more peripherally in the nerve. Forward the central vein came into view as a single vessel, or as two, three, or four channels formed either by canalization of an old thrombus or by formation of new venous channels. The case seems to prove that it is possible to have thrombosis of the central vein without hemorrhage. Two changes were taking place: gradual localized occlusion of the vein and equally gradual formation of collateral channels. (7 illustrations.)

Beulah Cushman.

Ballantyne, A. J., and Loewenstein, A. **The pathology of diabetic retinopathy.** Trans. Ophth. Soc. United Kingdom, 1943, v. 63, pp. 95-115.

This histologic report is based on examination of nine specimens, the posterior half of the eyeball being used in eight and the whole eyeball in one. The endothelial cells were found sprinkled with fatty droplets of varying size and density, sometimes arranged as a belt around the lumen. In other places, where the fatty infiltration of the endo-

thelium was of notable degree, the wall of the vessel had become ectatic, forming an aneurysm. Clinically the aneurysmal changes appeared as globular bodies attached to the vessels in series, like strings of beads, or as isolated spherical bodies consisting of closely packed red blood corpuscles enclosed within a capsule. If unconnected with a vessel these bodies are called encysted hemorrhages. They were identified as the small round spots found around the macula and described clinically as punctate hemorrhages.

Groups of fatty droplets were found 7 to 10 microns under the retinal surface and 40 to 50 microns deeper were found larger droplets. In the advanced cases retinal degeneration was extensive, with preretinal vessels embedded in a deep layer of primitive connective tissue which covered the surface of the retina, and which the authors call retinal pannus. Phlebosclerosis was seen in two forms: a nonsymmetrical fibrillary thickening of the vein wall with normal lumen, and a great thickening with complete hyalinization and narrowing of the lumen. (15 illustrations, references.) Beulah Cushman.

Knapp, Arnold. **Spontaneous retinal reattachment.** Arch. of Ophth., 1944, v. 32, Nov., pp. 403-406; also Trans. Amer. Ophth. Soc., 1944, v. 42.

The course of serous retinal detachment is sometimes curiously modified when the detachment of the retina remains stationary and there is reattachment which gives rise to a characteristic ophthalmoscopic picture. The detachment is shallow, and its upper boundary is bound down by chorioretinal changes, which constitute the most striking sign. The reattached, flat retina is generally changed to a paler, yellow gray; there are characteristic branching white subretinal lines and areas where the choroidal markings are more distinct and irregular retinal pigmentation is present. The upper boundary consists of organized exudate, which extends across the fundus below the disc in a curved or in a more or less straight line to the periphery on each side and divides the fundus into two dissimilar parts.

The present accepted explanation of the cause of retinal detachment assumes the presence of degenerative changes in the retina and in the vitreous body, with the formation of an adhesion between these two structures, this adhesion resulting in a tear of the retina due to rotatory movements of the vitreous body. This does not explain the causation of the detachment in the cases observed and described by the author. In these 16 cases the detachments occurred in young people, in whom degenerative changes are not frequent. Also, in the case of a dialysis the cause is entirely physical. Moreover, the adhesion of the vitreous to the underlying retina in the periphery of the eyeground is normally unusually strong, so that a pathologic process which binds the vitreous and the retina together need not be present. It is possible that the firmer texture of the vitreous body at its base explains why escape of the vitreous fluid in this type of detachment is moderate. Finally, an important factor in the shallowness of a detachment limited to the lower half of the eyeground may be the weight of the vitreous body, which acts most on the lower half of the fundus.

Notwithstanding the prospect of self-limitation of a retinal detachment which is limited to the lower half of the fundus, the author advises early

operation to avoid involvement of the macula and to preserve the visual field. (References, 2 drawings.)

R. W. Danielson.

Laird, R. G. **Iodide therapy for senile macular degeneration.** Amer. Jour. Ophth., 1945, v. 28, March, pp. 287-296; also Trans. Amer. Ophth. Soc., 1944, v. 42. (One table, references.)

Loewenstein, A., and Garrow, A. **A contribution to the anatomy of circinate retinopathy.** Trans. Ophth. Soc. United Kingdom, 1943, v. 63, pp. 120-135.

The authors give the histopathology of circinate retinopathy in the fifth case to be described since Jonathan Hutchison first mentioned the condition in 1876. E. Fuchs described it in 1893.

The eye was fixed in formol, sectioned in front of the equator, and studied at the slitlamp after removal of the vitreous body. The piece of retina containing the circinate changes was excised, cleared in glycerin, and examined microscopically, unstained and in bulk. The nerve-fiber pattern was clearly visible except in the circinate area. The discrete white shining dots sheathed vessels in several places, and with higher power the spots were resolved into rows of discrete reflecting droplets of different size, surrounding the clearly visible thickened vessel walls.

The piece of retina was then washed out and stained in bulk. With scarlet red the arcuate area appeared shining red. The higher power revealed that the sheathing of the larger vessel consisted of fat. Parts of the circinate area were embedded in gelatin, sectioned vertically, and counterstained with a thin solution of hematoxylin. The contrast of the nuclei with the red fatty droplets was very impressive. Two absolutely different foreign substances were found: fatty droplets mostly in round red patches situated throughout the whole retinal thickness, and a nonfatty substance in large spaces corresponding to the internuclear layer.

The vascular changes were at different levels. The capillaries varied from 3 to 15 microns in width and were dilated locally to form aneurysmal ectasias with different degrees of fatty-wall change. In some walls there was leakage, with exit of red blood corpuscles. Perfect chains of aneurysms emphasized the degree of vascular damage. Fatty changes were present in the central part of the intraretinal hemorrhages, and new blood vessels were seen. Most of the endothelial cells contained one or more fatty droplets. Apparently empty spaces in the outer granular layer corresponded to exudates. A gelatinous tissue covered the greater part of the retinal surface, and contained red blood cells and some vessels. The choroidal vessels were found to be normal. Their stroma contained fatty droplets.

The causal genesis may differ in different cases, and the authors conclude that circinate retinopathy is not an etiologic clinical entity but a form of cellular reaction in the retina. (15 illustrations, references.

Beulah Cushman.

Samuels, Bernard. **Complicated cataract associated with spontaneous detachment of the retina.** Arch. of Ophth., 1944, v. 32, Nov., pp. 416-422; also Trans. Amer. Ophth. Soc., 1944, v. 42. See Section 9, Crystalline lens.)

Shukla, K. N. **Evolution of the modern surgical treatment of retinal de-**

tachment. Indian Jour. Ophth., 1944, v. 5, July, pp. 55-59.

A general discussion of the subject, with reproductions of some illustrations from Arruga and from Cole Marshall.

Sverdlick, J. **Influence of the hypophysis and the suprarenal gland upon retinal pigment in "Bufo arenarum" Hensel.** Reprint of paper presented to Sociedad Argentina de Biología, June 11, 1942. (See Section 19, Anatomy, embryology, and comparative ophthalmology.)

Wolff, Eugene. **Ghost-rings on the internal limiting membrane of the retina.** Trans. Ophth. Soc. United Kingdom, 1943, v. 63, pp. 116-119.

The author identifies the rings often seen on the internal limiting membrane of the retina in histopathology as the product of disintegrated mononuclear cells. He feels that they represent one stage in disappearance from the vitreous cavity of those mononuclear cells derived from the ciliary body or retina. Probably the cell becomes swollen and the nucleus passes through the cell membrane leaving a ghost-ring, while later the nuclear contents pass out of the nuclear membrane leaving the smaller ghost-ring and finally the rings break down into granules. (4 illustrations.) Beulah Cushman.

11

OPTIC NERVE AND TOXIC AMBLYOPIAS

Basar, Irfan. **Optic atrophy after intestinal hemorrhage.** Göz Klinigi, 1944, v. 2, no. 1, p. 7.

A 39-year-old patient suffered from duodenal ulcers for twelve years. After hematemesis lasting several days he lost the vision of his left eye. Some weeks later this eye showed atrophic disc, constriction of the visual field, and central scotoma. The patient could count fingers at 3 feet.

Joseph Igersheimer.

Cohen, Martin. **Binocular papilledema in a case of torulosis associated with Hodgkin's disease.** Arch. of Ophth., 1944, v. 32, Dec., pp. 477-479.

Torula, a pathogenic yeastlike organism, may cause disturbances in the central nervous system, often with fundus lesions. It is noteworthy that in at least 10 percent of the reported cases the torulosis was associated with Hodgkin's disease. This is too frequent an occurrence to be a mere coincidence, but so far the relationship of the two diseases has not been established.

The author reports the case of a 36-year-old woman who was first seen because of visual deterioration of two months standing. She complained of severe headaches, accompanied by drowsiness and intermittent vomiting. The cervical lymph glands were enlarged. Both fundi showed papilledema, hemorrhages and exudates. The cerebrospinal fluid pressure was greatly increased, and torula histolytica could be cultured from the fluid. This organism was also found in cultures of the urine. Administration of sulfadiazine had no marked effect. Ventricular drainage was done for a week with some visual improvement. The patient developed a superimposed intracranial infection with nonhemolytic streptococci. The discs remained edematous and became grayish, the vision being completely lost. The patient's condition grew progressively more serious, with nuchal rigidity, opisthotonos and tremors of the upper extremities. He

died in coma. At autopsy, findings typical of Hodgkin's disease were found in the thoracic, abdominal, and cervical nodes. Torulas were demonstrated in the brain tissue, as well as in the secretions covering the cortex of the cerebrum and pons. Pericellular infiltration of the pia-arachnoid of the optic nerve was observed. (One color plate, including 5 figures; references.)

John C. Long.

Cox, R. A. **Amblyopia resulting from hemorrhage.** Arch. of Ophth., 1944, v. 32, Nov., pp. 368-371.

Occasionally after profuse distant hemorrhage there is noticed immediately, or more frequently after the lapse of days, a sudden diminution of vision, which often goes on to complete and permanent blindness, with the ophthalmoscopic picture of atrophy of the optic nerves. Deprivation of blood supply to any tissue will, if sufficiently prolonged, cause impairment or loss of function. If there is any correlation between delicacy of structure and of function, one may expect that those structures which are concerned with the most delicate functions will be earlier and more readily affected. Thus the retina will suffer before more coarsely constituted organs.

The resulting blindness is usually bilateral, and may be permanent or transitory. It usually comes on between the third and the seventh day after bleeding but may be delayed for some time. Recovery is possible even after light perception has been abolished for several days, provided the pupillary reaction to light is retained. In patients with a more favorable prognosis the amblyopia lasts from a few minutes to many hours. (One case report, fields, references.)

R. W. Danielson.

Flecker, H. **Sudden blindness after eating "finger cherries" (Rhodomyrtus macrocarpa).** Med. Jour. Australia, 1944, v. 2, Aug. 19, p. 183.

As early as 1894 reports indicated that eating of the fruit of Rhodomyrtus macrocarpa or finger cherry, a plant indigenous to north Queensland, could cause sudden and usually permanent blindness. Since not all who have eaten the fruit have been so afflicted the cases were reviewed as to ripeness of the fruit at the time of eating, and as to the possibility that a fungus, Gloeosporium periculosum, which commonly infests the overripe fruit, might be the causative agent. Seven cases in humans are briefly described, and cases in which blindness ensued in heifer calves and a goat after browsing on the fruit and foliage are recorded. Little is known about the clinical picture in the early stages. The late picture is usually one of primary optic atrophy with sluggish or inactive pupils. Some patients have retained light perception and hand movements in one or both eyes. In 1915 the Department of Education prepared a bulletin for distribution to the local schools of North Queensland, giving pictures of the plant and fruit with a discussion of its dangers. No cases have been reported during the subsequent years. The toxic factor has never been positively identified.

Owen C. Dickson.

12

VISUAL TRACTS AND CENTERS

Figueiredo, N. P. de. **Ocular symptoms of hysteria.** Rev. Brasileira de Oft., 1944, v. 3, Dec., pp. 74-93.

Imaginary blindness appeared due to emotional disturbance. The treatment consisted of an alleged operation, which was repeated several times.

Without anesthesia, on each occasion the eyeballs were grasped with forceps and moved in several directions. A weak solution of zinc sulphate was instilled and the eyes bandaged. The vision steadily improved, to reach normal in about a week. The author devotes a further 15 pages to a review of various ocular symptoms arising from hysteria. (References.) W. H. Crisp.

Oberndorf, C. P. **Ocular symptoms of psychogenic origin.** Arch. of Ophth., 1944, v. 32, Dec., pp. 443-446.

A mechanism known to the psychiatrist as "displacement" consists in the moving of genital "affects" from a primary object or function to a secondary one. When displaced associations become attached with sufficient tenacity to the secondary object, the latter may assume the functions of the first and may eventually become a welcome substitute for the primary one in fulfilling certain emotional needs of the organism. Substitutions springing from the unconscious as a result of persistent and constant repression of unacceptable "instinctual" urges often come to light. These urges, particularly the sexual ones, may continue when relief and satisfaction are normal. When they are suppressed but not relinquished, the denial of expression gives rise to complaints referred to various bodily systems. Such substitutions may take the form of physical complaints ascribed to many different organs. The ocular complaint may be "eyestrain," pain, blurring of vision, or even blindness.

The relationship of the eye to various neuroses is shown and clinical examples are given. Practical applications of the treatment of ocular neuroses are discussed. Often it is not advisable to tell the patient at once of the psychogenic nature of his ailment. The clinical psychotherapeutist must confine himself to presentation of such facts as seen valid in accordance with his method. The soundness of his work rests largely on recognition of the validity of such facts by the patient, and on disappearance of the symptoms when the inhibitions which necessitated conversion phenomena no longer operate. John C. Long.

13

EYEBALL AND ORBIT

Adler, F. H. **The role of exophthalmos in the diagnosis and treatment of Graves's disease.** West Virginia Med. Jour., 1944, v. 40, Oct., p. 136.

The earliest sign in the thyrotoxic type of Graves's disease is lid retraction. The cause of lid retraction is unknown. It gives rise to the other lid signs in Graves's disease, such as lid-lag and infrequent winking, and is the cause of the characteristic facial expression of thyrotoxicosis. Lid retraction causes a slight degree of exophthalmos, but simulates a much greater degree. It is not pathognomonic of Graves's disease.

Exophthalmos can be diagnosed only by actual measurement, and even then one can only assert the degree of protrusion of the globe is pathologic when (1) the condition is unilateral and the difference between the two eyes exceeds 1.5 mm. and (2) previous measurements have shown the increase to have occurred when the condition was bilateral. Two types of exophthalmos occur in Graves's disease. One type is due to the same mechanism as causes the lid retraction, hence is of slight degree, occurs in the cases which are thyrotoxic, and disappears when the

lid retraction disappears. No pathology is found in the orbit to account for this type. The other type is due to edema of the orbit, followed by cellular infiltration. It is progressive, especially in hypothyroid individuals, remains or gets worse even though the thyrotoxicosis is cured, and persists after death.

The signs by which this type of ophthalmopathic Graves's disease can be recognized are outlined as follows: (1) edema of the lids, noninflammatory; (2) edema of the bulbar conjunctiva, settling to the lower cul-de-sac, but not involving the palpebral conjunctiva; (3) progressive exophthalmos; (4) early limitation of movement of one or both globes due to proptosis: there is little diplopia since limitations are usually bilateral and in the same direction; (5) exophthalmos out of all proportion to signs of thyrotoxicosis; in fact, strikingly in the inverse proportion; hence most frequently seen in post-thyroidectomy cases. Ten case reports are presented, and the medical treatment outlined.

Theodore M. Shapira.

Gonçalves, Paiva. **Orbital varix (intermittent exophthalmos).** Rev. Brasileira de Oft., 1944, v. 3, Dec., pp. 57-63.

The patient, a young man, experienced severe pains in the left eyeball upon lowering his head or in ventral decubitus. Upon repeating the necessary maneuver, the eyeball protruded behind distended and congested eyelids. It took one or two minutes for the condition to quiet down, and by this time the pain was of such intensity that if anyone undertook to hold the patient with his head down he made violent efforts to release himself. Enophthalmos was manifest between the crises. The vision was equal to that of the other eye. The author proposed to try the effect of roentgen rays, and if these proved ineffective to resort to sclerosing injections. (4 photographs.)

W. H. Crisp.

Murphey, P. J., and Schlossberg, L. **Eye replacement by acrylic maxilofacial prosthesis.** U. S. Naval Med. Bull., 1944, v. 43, Dec., p. 1085.

A detailed description of the method of manufacture of artificial eyes as used by the Naval Dental School at the National Naval Medical center, Bethesda, Maryland, is given. Heretofore much was usually left to be desired in the fitting of protheses both as to good cosmetic result and as to restoration of normal facial contours.. Following study of the usual posterior socket wall and of the functions of the various extraocular muscles it was found that an adequate prothesis should have a superior fullness to support the upper lid, a posterior concavity to accommodate the rectus muscles, and occasionally an increased inferior lip to prevent ejection of the prothesis on upward gaze and also to enable the orbicularis to assist in elevation.

Details of the procedure include preliminary study of the patient, including photography to outline the problem, on through the making of a mold of the socket by use of one of the alginate gels, down to the production of an acrylic resin blank to represent the sclera. An artist draws a reproduction of the fellow iris on paper, which is then accurately placed in a bed prepared in the sclera. Finally clear fluorescent acrylic polymer is prepared and is molded over the iris to represent the cornea. The final prothesis is then polished, vessels painted on the sclera, and the prothesis tried on the patient. Any

necessary small modifications can be made by grinding and polishing.

The acrylic material used is only slightly susceptible to etching by the eye-socket fluids or secretions. If scratched from handling, it may easily be polished. The prothesis is resistant to the usual accidental stresses, and, if a clean break occurs, can be repolymerized or the entire eye duplicated. Pictures of end results are given as well as descriptions of the various steps in the process. Owen C. Dickson.

Romagosa, J., and Rackley, G. D. **Orbital cellulitis with severe cerebral symptoms.** New Orleans Med. and Surg. Jour., 1944, v. 97, Dec., p. 276.

This is the report of a case of severe orbital cellulitis possibly complicated by cavernous-sinus thrombosis. Although the prognosis at the outset seemed very grave, complete recovery followed therapy with sulfonamide drugs, penicillin, and later drainage of a supraorbital abscess. It is certain that this patient had severe orbital cellulitis with beginning extension backward into the cranial cavity and with possible thrombosis of the cavernous sinus. It is almost certain that without chemotherapy death would have occurred before localization of the infection and abscess formation could take place. It is difficult to evaluate the relative roles played by the sulfonamide drugs and penicillin in this case, since they were administered concomitantly. It should be noted, however, that marked improvement occurred after intravenous administration of sulfathiazole and before penicillin could be obtained.

Theodore M. Shapira.

Ruedemann, A. D. **Eye changes in disease of the thyroid.** Jour. Lancet, 1944, v. 64, Nov., p. 376.

The author presents a review of over 10,000 cases of thyroid disease. The fact that it may be only part of a polyglandular difficulty is stressed. Overaction of the thyroid, toxic thyroid, or hyperthyroidism is the only disturbance producing exophthalmos of a high degree. Colloid goiter and hypothyroidism, except when the basal metabolism is very low, affect to a lesser degree. Persistently wide palpebral fissures should make one suspicious of hyperthyroidism in either children or adults. Neurocirculatory asthenia must be ruled out by the result of bed rest, by rapidly falling basal rate, and so on. If the exophthalmos is bilateral or progressive, surgery to the thyroid is indicated. The duration of the exophthalmos prognosticates the amount of recession later, averaging about 2 mm. (Hertel). Muscle errors are common and persistent, and may require exercise or surgery. Corneal ulceration is infrequent and is due to exposure or some neuroparalytic factor. Exophthalmos of hypothyroidism is bilateral and is associated with edema of the upper and lower lids.

Owen C. Dickson.

Stephenson, W. V. **Anterior megalophthalmos and arachnodactyly.** Amer. Jour. Ophth., 1945, v. 28, March, pp. 315-317. (References.)

15

TUMORS

Bruner, W. E. **Errors in diagnosis of intraocular tumors.** Amer. Jour. Ophth., 1945, v. 28, March, pp. 297-302; also Trans. Amer. Ophth. Soc., 1944, v. 42.

Goldsmith, A. J. B. **The effect of diathermy on a malignant melanoma of the choroid.** Trans. Ophth. Soc. United Kingdom, 1943, v. 63, pp. 88-94.

The author gives the histologic findings of the sarcomatous eye whose treatment with diathermy is reported by Williamson-Noble (see below under that name), and which was removed because of a large intraocular hemorrhage 27 days after the diathermy. A great part of the tumor was a necrotic mass. There was an area of active growth posteriorly and anteriorly. There were no blood vessels in the operative area. From the choroid in front of the tumor new capillary loops and fibroblasts were growing into the necrotic tumor mass. Two of the posterior ciliary vessels were thrombosed. The necrosis appeared recent and the author felt it was due to the diathermy and to loss of nutrition from thrombosis of the vessels.

The author concludes that complete destruction of a suitably placed choroidal growth of small size could be secured by diathermy coagulation, and that surface diathermy might be the safest method because of its avoiding dissemination. As many of the pigmented malignant tumors of neuroepithelial origin are radio-resistant, and large doses of radon, radium, or X rays would be necessary for effective treatment and damage to lens or retina might therefore result, he feels that diathermy, being almost entirely local in its effect on the blood vessels, is the method of choice once it has been decided not to enucleate the eye. (2 figures, references.) Beulah Cushman.

Williamson-Noble, F. A. **The effect of diathermy on a malignant melanoma of the choroid.** Trans. Ophth. Soc. United Kingdom, 1943, v. 63, pp. 85-86.

The author reports treatment of a sarcoma of the choroid with diathermy, in an eye without increased tension in a woman 44 years of age. Three days later a large hemorrhage occurred. As vision did not improve, the eye was enucleated 27 days after the diathermy operation. (And see under Goldsmith above.) Beulah Cushman.

16

INJURIES

Heppel, L. A., Neal, P. A., Endicott, K. M., and Porterfield, V. T. **Toxicology of dichloroethane.** Arch. of Ophth., 1944, v. 32, Nov., pp. 391-394.

This paper is concerned only with the peculiar action on the cornea of certain species of animals upon exposure to dichloroethane vapor in different concentrations. Eleven species of animals were used and four concentrations were employed; 3,000, 1,500, 1,000 and 400 parts per million parts of air. Each period of exposure was seven hours.

Exposure of dogs for seven hours to inhalation of dichloroethane in concentrations of 400, 1000 and 1500 parts per million led to bilateral swelling and turbidity of the corneas. Development of the turbidity was always bilateral, but the clearing process sometimes involved only one eye. When dogs were given repeated daily exposures to dichloroethane in a concentration of 1000 parts per million in series of five exposures and separated by rest periods of two days, they gradually became tolerant to the vapor. Eventually, no cloudiness developed after the exposures. Of eleven species of animals tested for sensitivity of the cornea to dichloroethane, namely, the rat, mouse, rabbit, guinea pig, hog, cat, raccoon, fox, dog, chicken and rhesus monkey, only the fox and the dog showed cloudy corneas. No cases of injury to the human cornea from dichloroethane

have been reported. (References, 2 figures.) R. W. Danielson.

Hessberg, R. J. **Problems of ophthalmology of modern warfare.** Vida Nueva, 1944, v. 18, Oct., pp. 149-218.

This exhaustive article deals with the subject under many headings, some of which are as follows: physical capacity of the soldier and the problem of compensation for injuries caused by war; requirements for entering military service; emergency treatment; perforating lesions; the obligation of the soldier to submit to operation; gas gangrene; tetanus infection; sympathetic ophthalmia; fractures of the orbit; contusion of the posterior part of the eye and detachment of the retina; head injuries; lesions in the interior of the orbit; radiography for demonstration of bullets in the cranium; lesions of the brain; importance of campimetry; traumatic retinopathy; gas injuries; burns and blasting injuries; surgery of reconstruction; care and reëducation of war blind. (No illustrations, no list of references.)

W. H. Crisp.

King, E. F. **Some observations in traumatic cataract.** Trans. Ophth. Soc. United Kingdom, 1943, v. 43, pp. 76-83.

Operative interference should not be undertaken until the reaction to the original trauma has subsided. Preliminary treatment should be conservative. The sulfonamides should be used early with any suggestion of an exogenous infection, and protein shock therapy should be repeated if necessary until five doses have been given at three-day intervals. Secondary glaucoma can usually be controlled with mydriatics and heat in the form of short-wave diathermy.

The treatment of traumatic cataract under optimum conditions depends somewhat on the condition of the second eye. The operation is technically easier if done within a few months or weeks of the original injury.

Operative interference is contraindicated if vitreous is in the anterior or posterior chamber, if there are anterior synechiae or thickened anterior capsule, and in patients past middle age unless intracapsular extraction is practicable. (One figure.)

Beulah Cushman.

McGuire, W. P., and Raffetto, E. C. **Construction of a contact lens for localization of intraocular foreign bodies.** U. S. Naval Med. Bull., 1944, v. 43, Dec., p. 1239.

A method of manufacturing a contact lens, using materials at hand in a dental prosthetic department, is described. A matrix of pink dental baseplate wax is molded to fit inside the lids of a standard patient. The matrix serves both as a lid retractor and as a form for holding the impression material, which consists of an alginate base-powder type which when mixed with water forms an elastic gel. The retarder of a unit of this type is first placed in 75 c.c. of water at 70 degrees F. and dissolved. The powder is then added and spatulated, and the mass is applied to the anesthetized eye. The setting time is four minutes. The resulting impression is accurate and should show a definite corneoscleral junction. The impression is then fixed, a stone cast poured, a wax pattern made and a clear acrylic resin lens processed. This is polished and placed in the eye and the vertical and horizontal meridia marked with pencil at the corneoscleral margin. Silver amalgam alloy is packed into small holes drilled into the anterior surface of the

lens at the above points. The lens is then polished and is ready for use.

The technique of use is the same as that described by Pfeiffer after the original description by Comberg. This is briefly given in the article. Their exposure factors are current strength of 30 milliamperes at a distance of 30 inches and an exposure of ¾ second. The anteroposterior view is taken at 75 kv. and the lateral at 58 kv. All views are taken with a 60-cycle current and full-wave rectification. (Drawings of lens.)

Owen C. Dickson.

Scherling, S. S., and Blondis, R. R. **Effect of chemical-warfare agents on the human eye.** Arch. of Ophth., 1944, v. 32, Nov., pp. 381-387.

With the possibility of gas warfare, it becomes apparent that clinical investigation of chemical agents so employed and their effects on the human eye is of paramount importance. The material for this study consisted of personnel at a chemical-warfare arsenal. The authors report in detail representative cases of (1) injury from mustard gas vapor, (2) injury from liquid mustard gas, (3) injury from lewisite vapor, (4) injury from lewisite, (5) injury from thermate and (6) injury from white phosphorus lime.

From their study, the authors draw the following conclusions: Photophobia and blepharospasm are constant complaints. The bulbar conjunctiva appears to suffer more than does the tarsal conjunctiva. Staining of the corneal epithelium after exposure to mustard gas is rapid and punctate, indicating a keratoconjunctivitis rather than a conjunctivitis only. Mustard-gas vapor produces rather characteristic edema of the corneal epithelium, the appearance being greasy and the process reversible. Absence of exudate and cells in the aqueous and of changes in the iris suggests that the products of corneal breakdown are not toxic if absorbed into the aqueous and that mustard gas does not pass unchanged through the cornea. Despite the fact that lewisite liquid and lewisite vapor have been proved to be as destructive to the skin as is mustard gas in corresponding form and dosage, the reported cases of contamination of the eyes show little serious effect. In none of these cases was there evidence of increased intraocular pressure.

The authors make the following recommendations: Homatropine is preferable to atropine since the corneal damage is transient and reversible. Casualties from vesicant agents need exist as such for only two days to two weeks, and the casualty time and the duration of symptoms and signs correspond to the clinical severity of the burn.

Use of glycerine, because of its hygroscopic effect, is recommended to combat the corneal edema that accompanies keratoconjunctivitis due to mustard-gas vapor. Contamination of the conjunctiva with particles of white phosphorus should be treated as elsewhere on the body surface, the medication including immediate use of a copper-sulfate solution. (2 tables, 2 photographs, references.)

R. W. Danielson.

Snell, A. C., Jr. **Perforating ocular injuries.** Amer. Jour. Ophth., 1945, v. 28, March, pp. 263-281. (16 tables.)

Unsworth, A. C. **Cordite as an intraocular foreign body.** Arch. of Ophth., 1944, v. 32, Nov., pp. 414-415.

Probably cordite has been introduced into the eyes in many wounds

due to explosions, but the entrance of the powder has been overshadowed by extensive damage or by the presence of other foreign material. The author presents two cases in detail. He concludes that cordite as an intraocular foreign body is in itself relatively innocuous, and that conservative treatment should be employed. References.

R. W. Danielson.

17

SYSTEMIC DISEASES AND PARASITES

Carroll, F. D. **The role of dental infection in diseases of the eye.** Connecticut State Dental Assoc. Bull., 1944, Dec. 11, pp. 37-41.

The author considers which diseases of the eye may be almost certainly caused by dental infection, which may probably be caused by this factor, and which are definitely not due to it. In the first class he includes uveitis, episcleritis, and orbital inflammation; in the second class certain cases of blepharoconjunctivitis, keratitis, and macular disease; and among those never or almost never related to dental infection he places retrobulbar neuritis, senile cataract, and primary glaucoma. In slowly tracing down the etiology of one eye disease after another, the role of foci of infection has diminished. A sense of balance is essential in the evaluation of this medical problem. On the other hand, although dental infection is now considered an infrequent cause of eye disease, it may in any particular case be of great importance. (References.) W. H. Crisp.

Hogan, M. J., and Cordes, F. C. **Lipochondrodystrophy.** Arch. of Ophth., 1944, v. 32, Oct., pp. 287-295.

Lypochondrodystrophy is a rare congenital disease characterized by chondrodystrophic changes in the skeleton and deposition of a lipid-like substance in many of the tissues, including the cornea. The disease is first noticed about the first year of life, when dorsolumbar kyphosis and enlargement of the head become apparent. By the age of four years normal growth has largely ceased. The head is enlarged, and deformed by saddle nose, wide-set protuberant eyes, and thickening of lips and tongue. The abdomen is protuberant, with an umbilical hernia and enlargement of the liver and spleen. The joints of the extremities present deformities and limitation of motion. In over 75 percent of cases a distinct cloudiness of the corneas appears before the age of three years. The corneas have a ground-glass appearance and are diffusely hazy. The haze is produced by tiny gray or yellow-gray dots which eventually become distributed throughout the stroma.

The authors report the pathologic findings of three cases of this disease examined at autopsy. Two of the patients were brothers whose clinical findings had been reported previously. One of the children died at the age of 6½ years of pulmonary tuberculosis, one of a respiratory infection at the age of five and one of hydrocephalus at the age of five years. Detailed studies of the corneas were made to determine the cause of the haze. The corneal changes were found to be limited to the region of Bowman's membrane and to the corneal corpuscles. There was an infiltration of numerous large phagocytic cells into the region of Bowman's membrane, with thinning and rupture of the membrane. The corneal corpuscles were swollen. Both the phagocytic cells and the corneal corpuscles showed

numerous fine granules in their cytoplasm. These granules could be seen in frozen sections but could not be found in tissues prepared in fat solvents, an indication of their possible lipid nature. The granules, however, did not take the usual stains for fats. The findings of the authors closely correspond to those of two of the three other observers who have reported histologic examinations of eyes in lipochondrodystrophy. (7 illustrations, references.)

John C. Long.

Isola, W., and Osimani, J. J. **A new case of conjunctival ophthalmomiasis produced by Oestrus ovis in Uruguay.** Arch. Uruguayos de Med., Cirugia y Especialidades, 1944, v. 25, Sept., pp. 260-264.

The only case previously published in Uruguay was reported in 1925 by Gaminara. The present case was in a youth of 18 years, who gave the history that three days previously, while taking his siesta in the shade of a tree, he had been pestered persistently by an unusually large fly, which in spite of all his efforts succeeded in striking his right eye. He had no immediate discomfort, but the next day had a definite sensation of a foreign body in the right eye, with which was associated mild irritation of the conjunctiva.

The patient discovered the presence of a small "worm" which wriggled vigorously in the conjunctival sac; he removed it easily. In the course of the same day he was able to extract four new "worms." Two days later medical examination disclosed the presence of two more larvae, each about 1 mm. long, one adherent to the tarsal conjunctiva and the other to the upper bulbar conjunctiva. Microscopic study indicated that the larvae were of the species Oestrus ovis L. The authors confirm the opinion of Gailliard that the monograph by the Russian author Portchinsky is erroneous in showing "thorns" on the abdominal instead of the dorsal surface of the larvae. Special attention is called to the characteristic tenacity of Oestrus ovis in making its deposit of eggs; such characteristic having been noted in previously reported cases. (References.) W. H. Crisp.

Rudolph, C. J. **Eye findings in rheumatic fever.** Amer. Jour. Ophth., 1945, v. 28, March, pp. 319-321. (References.)

18

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Anson, B. J. **Conceptions of structure, function, and diseases of the eye in the collected works of Ambrose Paré.** Quarterly Bull. Northwestern Univ. Med. School, 1944, v. 18, no. 3, pp. 244-255.

Organs were considered hollow tubes or pulpy masses. A bodily organ was said to be able to exert a normal action when the vaporous spirit or pneuma was strong and pure, and was assisted by a proportionate mixture of four essential juices, termed humors. If the spirit became weak or the humors degraded either by the direct effect of heat or cold, or by deleterious aerial particles, the organs were diseased. The doctor cleared the organs of humoral wastes by blood-letting, and strengthened the spirit by dietary means.

The eyes were said to be composed of six muscles, five coats, three humors, and "a most bright spirit"; furthermore, of two nerves, a double vein, and one artery. The visual spirit enclosed

in the eye was described as transmitting a physical image of the environmental scene through the humors along the canalized optic nerve to the ventricular headquarters of the spirit. In the ventricles the spirit was stored and refined, and sent or received by way of the hollow nerves. (2 figures.)

R. Grunfeld.

Biram, J. H., and Barton, P. N. **Vision and accident repeaters.** Indust. Med., 1944, v. 13, Sept., p. 683.

Two control groups and one accident-repeater group totalling 280 employees were studied, using the American Optical Company's industrial visual testing device with vectograph target. Lack of binocular vision was found in 10 percent of the accident-repeater group, and in 3.3 percent of control groups 1 and 2. Distant depth perception was below normal in 46.6 percent of the accident repeaters. On applying these percentages to preplacement candidates one would lose 4.4 good candidates for each accident repeater eliminated, an increase in rejection rates of 26.5 percent of all preplacement candidates.

A similar study of the horizontal phorias revealed that 15 out of every 100 accident repeaters would be eliminated, with a loss of 42 nonaccident-repeaters. This would increase the rejection rate percentage 8.1 percent.

Although there is some correlation between certain visual defects and the accident-prone worker, these factors alone do not justify rejection of a worker for a hazardous job. It is suggested that with the above there should be combined dexterity tests and other psychologic tests, although these alone have not proved too successful in determining job placement.

Owen C. Dickson.

Carr, E. F. **Bibliography of early ophthalmological works in the Archibald Church Library.** Quarterly Bull. Northwestern Univ. Med. School, 1944, v. 18, no. 3, pp. 238-243.

The author enumerates and comments upon the rare books on ophthalmic subjects, 32 in number, to be found in the Archibald Church Library. Three of the rare books were printed in the 16th, 5 in the 17th, and the rest in the 18th century. (10 illustrations.)

R. Grunfeld.

Chance, Burton. **Johannes Müller.** Arch. of Ophth., 1944, v. 32, Nov., pp. 395-402.

Johannes Müller, a German doctor of the 19th century, is chiefly notable in the field of ophthalmology for his observations on the mechanism of sight. His principal contributions were his explanations of color sensations caused by pressures on the globe, "pressure phosphenes"; of the adaptation of the eyes for sight at different distances; of single vision with two eyes; of the cause of single vision; and of phenomena of double vision.

Of greatest value was Müller's comprehension of binocular vision. He observed that in normal eyes the movements of the eyes would always cause the images to fall directly on corresponding parts of the two retinas, producing single vision. If, on the contrary, from various causes the images fell on noncorresponding points, double vision resulted. Müller assumed that single vision was effected by the passage of similar fibers from these points to the brain, which became united and gave rise to the consciousness of a single object.

Müller, in spite of his greatness, did not make any discovery in ophthal-

mology of the highest rank, but he did investigate and turn to the best account what others had discovered. (One reference, 9 figures.)

R. W. Danielson.

Gover, M., and Yaukey, J. B. **Defective vision as determined by the Snellen test, and other chronic conditions.** Public Health Reports, 1944, v. 59, Sept. 8, pp. 1171-1184.

The Farm Security Administration organized clinics for examination of members of white and Negro borrower families residing in 11 Southern States and six Northern or intermediate States. These families represent a low-income farm population and the researches were made in connection with a rehabilitation program. Curves of age prevalence of defective vision as determined by the Snellen test are presented. These show less defective vision than urban groups, especially between the ages of 20 and 45 years. Defective vision is less frequent among Negroes than whites for both male and female groups in practically every locality. White females have more defective vision than white males, and among the Negroes the same proportion is noted, for every age group. The incidence of pterygium is higher among white males. Negroes have higher rates than whites for cataract, whites have higher rates for strabismus and trachoma. Outstanding are the high prevalence of cataract in Florida and of trachoma or suspected trachoma in Arkansas. (References.)

M. Lombardo.

Hillman, C. C. **The Army rehabilitation program for the blind and deafened.** Arch. Physical Therapy, 1944, v. 25, Aug., p. 478. (See Amer. Jour. Ophth., 1944, v. 27, Nov., p. 1332.)

Knapp, A. A. **Eyeglasses for combat.** U. S. Naval Med. Bull., 1944, v. 43, Nov., p. 964. (See Section 3, Physiologic optics, refraction, and color vision.

Koch, F. L. P. **Patron saints of the eyes: an outline.** Amer. Jour. Ophth., 1945, v. 28, Feb., pp. 160-172. (10 figures.) Also Trans. Amer. Ophth. Soc., 1943, v. 41, p. 490. (16 figures.)

Mann, W. A. **Contributions of Sanford R. Gifford to the literature.** Quarterly Bull. Northwestern Med. School, 1944, v. 18, no. 3, pp. 215-223.

Gifford wrote two text books, the Textbook of Ophthalmology and the Handbook of Ocular Therapeutics, and about 150 scientific articles. Although a few of the articles were mere reviews, all of them were especially instructive, easily readable, and thought-provoking. (List of publications of Gifford.)

R. Grunfeld.

Post, L. T., and Slaughter, H. C. **National ophthalmological societies in the United States.** Ophth. Ibero Amer., 1944, v. 6, no. 1, pp. 26-29 (in English), and pp. 30-34 (in Portuguese). (See Amer. Jour. Ophth., 1944, v. 27, p. 1225.)

Puntenney, I., and Spear, D. **Some practical procedures employed by Dr. Sanford R. Gifford.** Quarterly Bull. Northwestern Med. School, 1944, v. 18, no. 3, p. 223-231.

A few of the contributions made by Sanford Gifford to the teaching and practice of ophthalmology are enumerated by the authors as they saw them applied in everyday practice. (2 figures.)

R. Grunfeld.

Riemer, H. B. **Topographic and etiologic study of 1,176 indigent blind**

persons in Massachusetts. Arch of Ophth., 1944, v. 32, Oct., pp. 304-307.

In the past it has been very difficult to obtain any indication of either the number of blind persons or the causes of blindness in a community. The Federal Social Security Board, in extending aid to the states for care of the indigent blind, has insisted that blind applicants be examined by competent ophthalmologists and that records be kept of the defects found. This has made it possible to obtain reliable statistics on the causes of blindness among the indigent.

The author reviews the findings in 1,176 cases of blindness in the state of Massachusetts. The data are summarized in three tables giving the topography and type of disease, an etiologic classification, and the age at onset of blindness. Glaucoma, with 111 cases, headed the list of diseases involving the eyeball, and myopia was second with 100 cases. There were 38 cases of blindness due to structural anomalies of the globe. Corneal disease was responsible for 187 cases and diseases of the iris and ciliary body for 100. There were 18 cases of sympathetic ophthalmia. Lens abnormalities were responsible for 181 cases. Involvement of the choroid and retina caused blindness in 217 cases, of which there were 60 of chorioretinitis, 59 of retinal degeneration, 37 of retinal hemorrhage, 29 of arteriosclerotic disease, and 25 of separated retina. In 205 cases blindness was caused by disease involving the optic nerve and visual pathway.

Infectious diseases produced blindness in 376 cases, of which syphilis was responsible for 128. Trauma, including chemical burns, accounted for 61 cases. In 13 cases blindness was due to poisoning and in 18 to neoplasm. General diseases were responsible for 93 cases, of which diabetes produced blindness in 45 and vascular disease in 40. In 152 cases blindness was due to conditions of prenatal origin, including 141 cases of retinitis pigmentosa.

Statistical studies of the causes of blindness form the basis of any real program of prevention. The present study emphasizes the following needs: Enforcement of all laws enacted for the control of infectious disease; more care in reporting causes of blindness; early detection of glaucoma and diabetes; prevention of injuries; authentic data on cases in which blindness is hereditary; adequate measures to assure proper medical care so as to prevent onset of blindness. (3 tables, references.) John C. Long.

Unsworth, A. C. **A discussion of ocular malingering in the armed services.** Amer. Jour. Ophth., 1945, v. 28, Feb., pp. 148-159. (References.)

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ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Stone, L. S. **Functional polarization in retinal development and its reëstablishment in regenerating retinae of rotated grafted eyes.** Proc. Soc. Exper. Biol. and Med., 1944, v. 57, Oct., p. 13.

Because of the regenerating faculty of adult salamander eyes after interruption of either nerve supply or blood supply, or after total transplantation, interesting experimental work on orientation of spatial localization is possible. Rotation of an eye through 180 degrees without interruption of the nerve or blood supply totally reversed the direction of motor activity resulting from visual stimuli, indicating definite quadrantic localization of visual and tectorial stimuli. Restora-

tion of the eye to normal position restored the usual visuomotor responses.

Rotation of an eye 180 degrees after excision, in which regeneration of the retina was necessary before vision returned, revealed the same reversal of quadrantic localization as in simple rotation without excision. Experiments are under way on larval and embryonic stages to determine the time at which retinal spatial differentiation is established. So far rotation of the cup in embryos results in no alteration in normal orientation.

Owen C. Dickson.

Sverdlich, J. **Influence of the hypophysis and the suprarenal gland upon retinal pigment in "Bufo arenarum" Hensel.** Reprint of paper presented to Sociedad Argentina de Biologica, June 11, 1942.

The author describes a series of experiments upon these frogs. After ligation of some of the principal arteries, Ringer's fluid is carried into the circulation, replacing the blood stream. When the Ringer solution is clear, Held's fixation fluid is introduced, so as to fix the organs and tissues of the cephalic region. The method was applied to 54 animals, and 108 eyes were studied histologically. Some frogs were used as controls, some after removal of the hypophysis, some after removal of the suprarenals.

It was found that the retinal pigment in this frog expanded in light and retracted in darkness. After removal of the hypophysis, illumination produced moderate retraction, although less than in the control animal exposed to darkness. After injection of extract of the posterior lobe of the hypophysis, illumination caused complete expansion of the pigment in the hypophysectomized animal, but there was no effect in darkness. The suprarenal gland did not appear to have any physiologic effect on the reactions to light and darkness. Adrenalin expanded the pigment after exposure to either light or darkness.

W. H. Crisp.

Vidal, F., and Marbrán, J. L. **Arrangement of the myelinic fibers in the optic tract of the cat.** Arch de Oft. de Buenos Aires, 1942, v. 17, Dec., p. 733.

In 24 cats of different ages, retinal microlesions were produced and one or both eyes enucleated after a period of time ranging from nine days to ten months. The specimens were studied with the Weil and Marchi technique as modified by Zwank-Davenport. On the basis of this experimental work it is concluded that the degenerated primary fibers of the optic tract end or lose their identity in the zone of the ventral geniculate body. Enucleation of one eye showed the number of crossed fibers to be greater than the number of homolateral fibers. Osmium tetraoxide stain showed the optic fibers to be arranged in two bundles: (a) the larger bundle, occupying the lateral portion; (b) the smaller bundle, occupying the medial border. The homolateral fibers run along the external border of the tract. The retinal microlesions produced by cathclysis and studied with the osmium-tetraoxide stain show that the inferior homolateral fibers run along the external border of the tract, while the superior homolateral fibers are situated toward the medial border. (Photomicrographs, bibliography.)

Plinio Montalván.

Warkany, J., and Schraffenberger, E. **Congenital malformations of the eyes induced in rats by maternal vitamin-A deficiency.** Proc. Soc. Exper. Biol. and Med., 1944, v. 57, Oct., p. 49.

The occurrence of anophthalmos and microphthalmos in pigs whose mothers had been fed a diet deficient in vitamin A has been demonstrated. The authors have developed what they term "open eyes" in three still-born litters of experimental rats which had been fed diets deficient in vitamin A. Nine of the other mothers in the series resorbed their embryos, the three previously mentioned being the only ones to carry their litters toward term.

In the abnormal "open eye" there is no clear differentiation of lids and cornea, and the anterior chamber is present in a rudimentary form only. In the normal eye the vitreous can be seen between the lens and the retina, whereas the same space in the abnormal eye is filled with connective tissue. The retina of the abnormal eye is folded and disorganized. In the closed abnormal eye the lids are fused with the cornea, and the anterior chamber appears as a linear space between the thick membrane thus formed and the lens. In several specimens a cleft can be seen in the inferior part of the retina, and a strand of connective tissue penetrates this cleft and spreads out in the space between the lens and the retina. This cleft represents a coloboma of the retina. No such abnormality was present in control series. (Microscopic pictures shown.)

Owen C. Dickson.

NEWS ITEMS

Edited by Dr. Donald J. Lyle
904 Carew Tower, Cincinnati 2

News items should reach the editor by the twelfth of the month

Deaths

Dr. William A. Ackroyd, Binghamton, New York, died February 9, 1945, aged 58 years.

Dr. Henry R. Boettcher, Chicago, Illinois, died February 8, 1945, aged 78 years.

Dr. Wallace R. Briggs, Sacramento, California, died December 18, 1944, aged 50 years.

Dr. George A. Crafton, Fulton, Kentucky, died December 17, 1944, aged 56 years.

Dr. William M. Edmonds, Tonawanda, New York, died January 11, 1945, aged 54 years.

Dr. John A. Flury, Saint Louis, Missouri, died January 9, 1945, aged 58 years.

Dr. Elmer F. Fuqua, Atlanta, Georgia, died January 6, 1945, aged 64 years.

Dr. John H. Garey, Berlin, Pennsylvania, died November 9, 1944, aged 93 years.

Dr. Peter A. Helgesen, Lake Mills, Iowa, died January 19, 1945, aged 76 years.

Dr. Herbert J. Hopkins, Pittsburgh, Pennsylvania, died December 14, 1944, aged 77 years.

Dr. Charles E. Magoun, Sioux City, Iowa, died December 18, 1944, aged 56 years.

Dr. Benjamin H. Mann, Philadelphia, Pennsylvania, died November 22, 1944, aged 58 years.

Dr. John C. O'Gwynn, Mobile, Alabama, died January 13, 1945, aged 65 years.

Dr. Terigi R. Paganelli, New York, New York, died February 18, 1945, aged 63 years.

Dr. Harry C. Parker, Gulfport, Florida, died January 11, 1945, aged 67 years.

Dr. Charles E. Walker, Jr., Denver, Colorado, died November 22, 1944, aged 41 years.

Dr. Emil H. Webster, Sault Sainte Marie, Michigan, died January 19, 1945, aged 75 years.

Miscellaneous

The American Board of Ophthalmology will hold an examination at Los Angeles in January, 1946, at the time of the Mid-Winter Course.

Applications for this examination must be filed before September 1st.

For details prospective candidates should write at once to Dr. S. Judd Beach, Secretary, Cape Cottage, Maine.

Formation of The Eye Bank for Sight Restoration, Inc., which will collect and preserve healthy corneal tissues from human eyes for transplanting to blind persons who have lost their sight because of corneal defects, was recently announced. The organization, national in scope, has been incorporated under the laws of New York State, and 22 leading hospitals in New York City are now affiliated with it. In addition, 20 outstanding ophthalmologists throughout the country will serve in an advisory capacity. Headquarters are at 210 East 64th Street, New York City.

The officers are Stanley Resor, president; Dr. R. Townley Paton, vice-president; Cyril B. Hartman, secretary; Walter C. Baker, treasurer; and Mrs. Henry Breckinridge, executive director.

It has been announced by the National Society for the Prevention of Blindness that Dr. Willis S. Knighton, New York, will serve as chairman of the Committee on Glaucoma of the National Society for the Prevention of Blindness, succeeding the late Dr. Mark J. Schoenberg. Additions to the Committee on Glaucoma include Major Fred Heffinger, superintendent, and Dr. F. L. P. Koch, chief of the Glaucoma Clinic, Manhattan Eye, Ear, and Throat Hospital, New York City.

The sixth annual William Thornwall Davis Postgraduate Course in ocular surgery, pathology, ocular motility, and orthoptics will be given at the George Washington University School of Medicine, Washington, D.C., May 28-June 2, 1945. The Army Institute of Pathology, directed by Col. J. E. Ash, MC, A.U.S., will give the course in eye pathology as has been done in former years. The surgery, ocular motility, and orthoptics will be given by the resident staff of the Department of Ophthalmology under the direction of Dr. Ernest Sheppard, Professor of Ophthalmology. The course is limited to 30 registrants.

The program for the coming meeting of the Pan-American Congress of Ophthalmology, which is to be held in Montevideo, Uruguay, the week of November 25, 1945, is practically completed, and will be published in the very near future. As was done at the last Congress, all papers will be in Spanish, Portuguese, or English, with projected translations as the paper is being presented.

Any recognized ophthalmologist is eligible for membership. The annual fee is $5.00, payable to Dr. Conrad Berens, Treasurer, 218 Second Avenue, New York 3, New York. That fee entitles the member to receive gratis the official organ of the Congress, "Ophthalmologia Ibero Americana," which is a quarterly trilingual abstract journal.

Tentative travel arrangements are being made with the Pan-American Airways, as well as the American Express Company, but these cannot be concluded definitely until there has been a further turn in world affairs.

The fourteenth semi-annual postgraduate conference in neuromuscular anomalies of the eyes was held at the Children's Memorial Hospital at Chicago, Illinois, by George P. Guibor, M.D., from May 6th to 11th, inclusive. Among the guest lecturers were Drs. Hendrie W. Grant, Aubrey Pember, and Avery Prangen.

The John O. McReynolds Lectureship was inaugurated April 6th by Dr. James W. White of New York who spoke on "Treatment and prevention of neuromuscular eye defects." This lecture was established at the University of Texas Medical Branch, Galveston, by Col. and Mrs. Frank W. Wozencraft, who were among the honor guests.

Societies

The forty-second meeting of the Reading Eye, Ear, Nose, and Throat Society was held in Philadelphia, Wednesday, February 21, 1945. The Eye Section attended medical and surgical clinics and a lecture by Dr. Wilfred E. Fry, at Wills Hospital.

The Brooklyn Ophthalmological Society held its regular meeting on April 19th at the Towers Hotel. The following scientific program was presented: "Hypertension and retinal vascular disease" by Dr. William Dock, discussed by Dr. Edwin P. Maynard with regard to medical aspects and Dr. John N. Evans with reference to ophthalmologic aspects; and "A clinical study of the effect of tobacco inhalation on the normal angioscotoma" by Dr. Austin I. Fink.

At the March 27th meeting of the Milwaukee Oto-Ophthalmic Society Dr. Peter C. Kronfeld of Chicago spoke on "Causes of failure of anti-glaucomatous operations."

The Los Angeles Society of Ophthalmology and Otolaryngology appointed the following officers for 1945: Dr. Orrie E. Ghrist, president; Dr. Alfred R. Robbins, vice-president; and Dr. K. C. Brandenburg, secretary-treasurer. Meetings take place at the Los Angeles County Medical Association Building, 1925 Wilshire Boulevard, Los Angeles, on the fourth Monday of each month from September to May, inclusive.

The Association for Research in Ophthalmology has canceled its 1945 meeting in coöperation with the war-travel and convention program. Essayists are requested to reserve their manuscripts for a possible meeting in 1946, in conjunction with the convention of the American Medical Association.—Brittain F. Payne, Lt. Colonel (MC), Secretary-Treasurer, AAF School of Aviation Medicine, Randolph Field, Texas.

The annual Congress of the Ophthalmological Society of Egypt was held at the Memorial Ophthalmic Laboratory, Giza, Egypt, on March 15th and 16th. Included in the program was a symposium on "Proptosis."